

Lecture 10 General Medicine_3rd semester

Microscopic structure of the skin

Microscopic structure of skin appendages and mammary gland

Development of the skin and skin appendages (derivatives)

the skin (cutis) covers the external surface and is heaviest single organ of the human body

- **cca 16 % of total body weight**
- **1.2- 2.3 m² in adults**

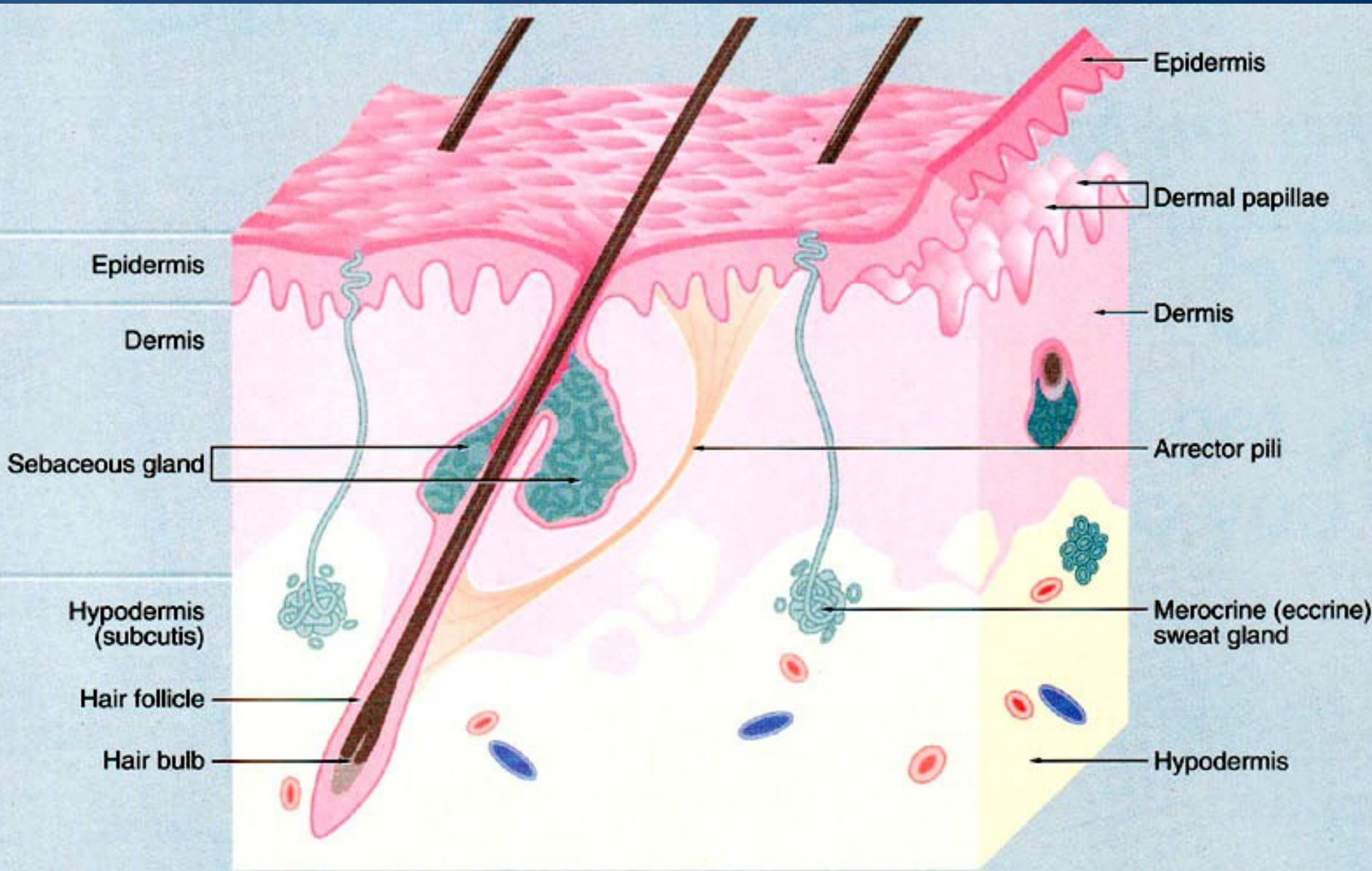
functions:

- **protects body against influence of the external factors,**
- **contains tactile, cold, heat and pain receptors,**
- **participates in immune response and processes,**
- **is involved in regulation of body temperature,**
- **serves as a complementary excretory organ (sebaceous and sudoriferous glands),**
- **takes part in gaseous exchange (to a limited extent)**

the skin consists of

- **epidermis** /an epithelial layer of ectodermic origin/
- **dermis** /a layer of connective tissue of mesenchymal origin/
and
- **hypodermis** or subcutaneous tissue /a layer of loose connective tissue that may contain pads of adipose cells, the **panniculus adiposus**/
- **skin appendages** - either **keratinised** (hair and nails) or **glandular** (sebaceous and sudoriferous glands)

the mammary gland is regarded as specialized and modified sweat gland (s)



Epidermis

Dermal papillae

Dermis

Arrector pili

Merocrine (eccrine) sweat gland

Hypodermis

Epidermis

Dermis

Sebaceous gland

Hypodermis (subcutis)

Hair follicle

Hair bulb

EPIDERMIS

is stratified squamous keratinized epithelium

cells are called **keratinocytes**

it contains 3 less abundant cell types: **melanocytes**, **Langerhans cells**, and **Merkel's cells**

2 types of the skin are distinguished:

the **thick (glabrous) skin** - found on palms and soles

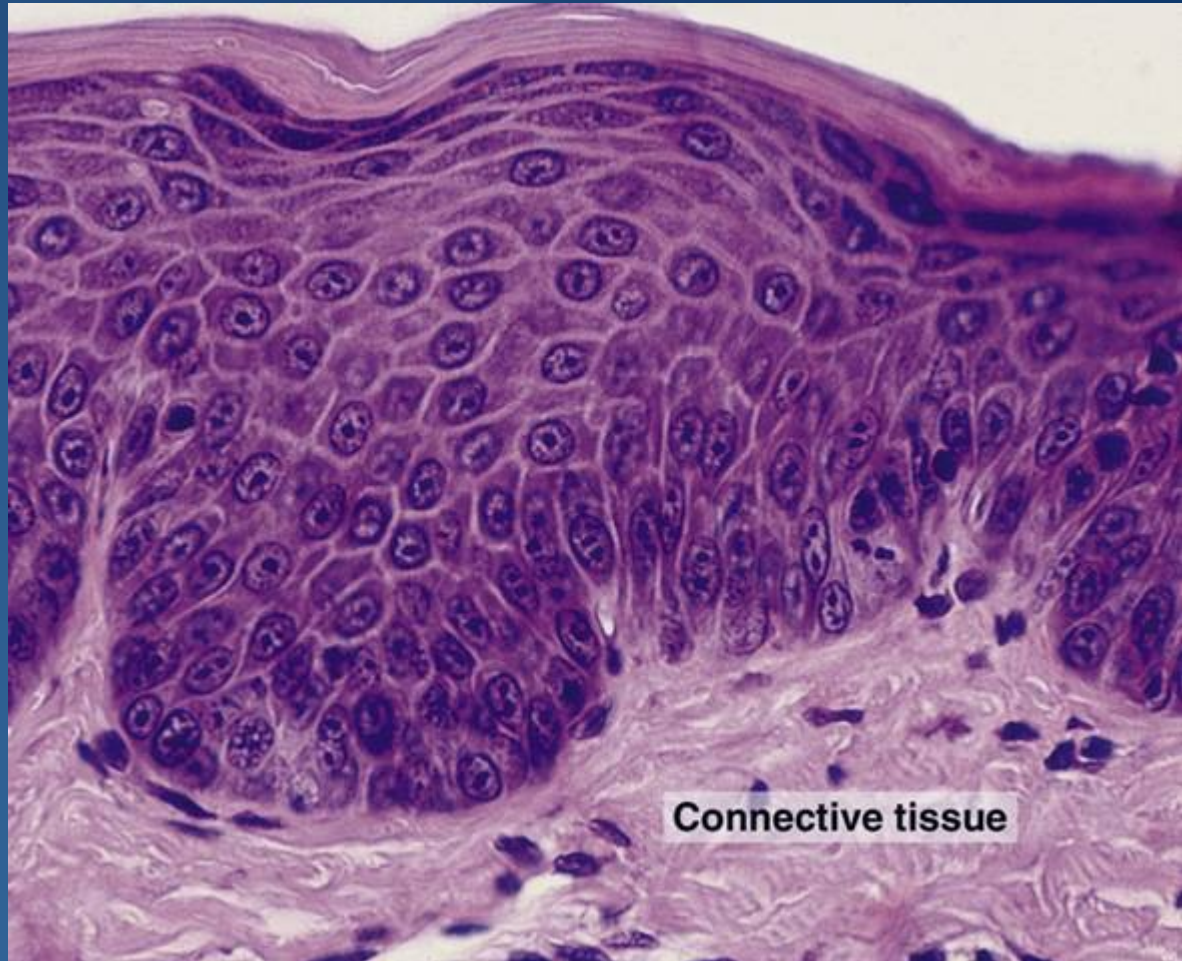
the **thin (hairy) skin** - found elsewhere on the body surface

„thick" and „thin" refer to the thickness of the epidermis - it

varies between 75 and

150 μm for the thin skin

and 600-800 μm for the thick skin/



5. Stratum corneum: lies at the surface, consists of 15-20 layers of flattened non-nucleated keratinised cells whose cytoplasm is filled with a birefringent filamentous scleroprotein – **keratin**

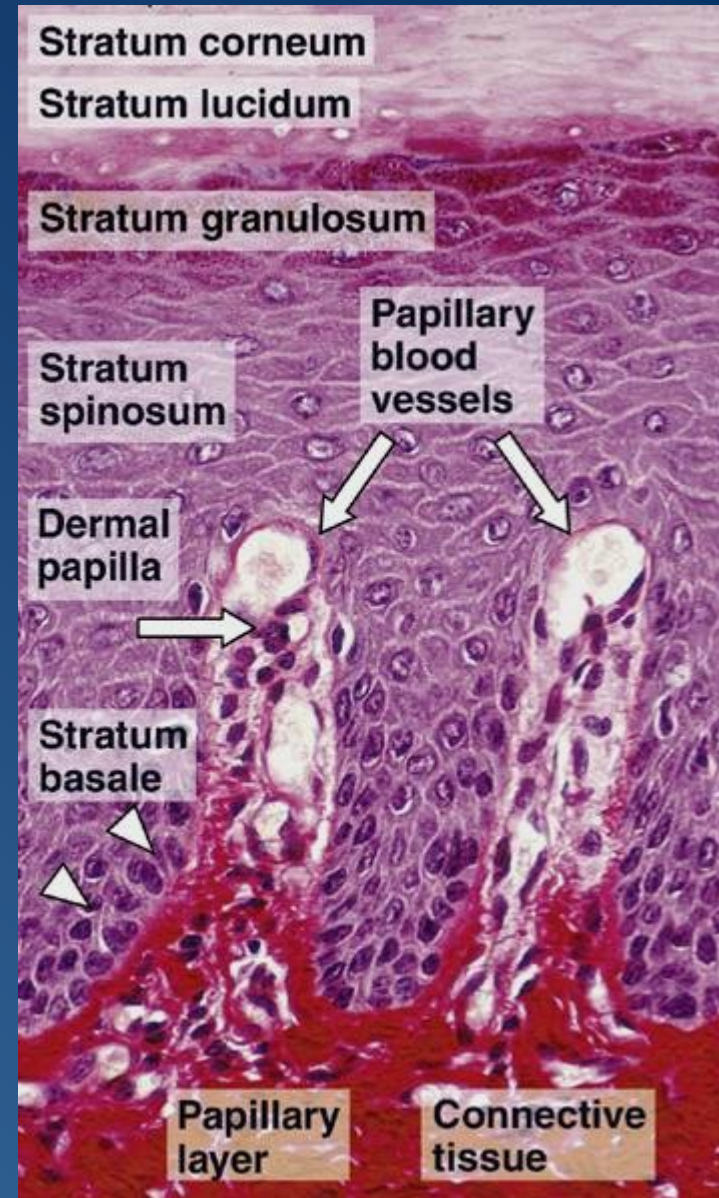
4. Stratum lucidum : translucent and thin
it lacks regularly in the thin skin; the layer contains dead, anucleated and eosinophilic cells, desmosomes are still evident

3. Stratum granulosum: 3 - 5 layers of flattened polygonal cells with **keratohyalin granules** and **membrane-coated lamellar granules** (composed of lamellar discs formed by lipid bilayers)

2. Stratum spinosum:
consists of cuboidal, polyhedral, or slightly flattened cells, the cytoplasm projects into processes that are filled with bundles of tonofilaments (under light microscope as tonofibrils)
cells in mitoses

both strata are called by common term as **stratum germinativum**

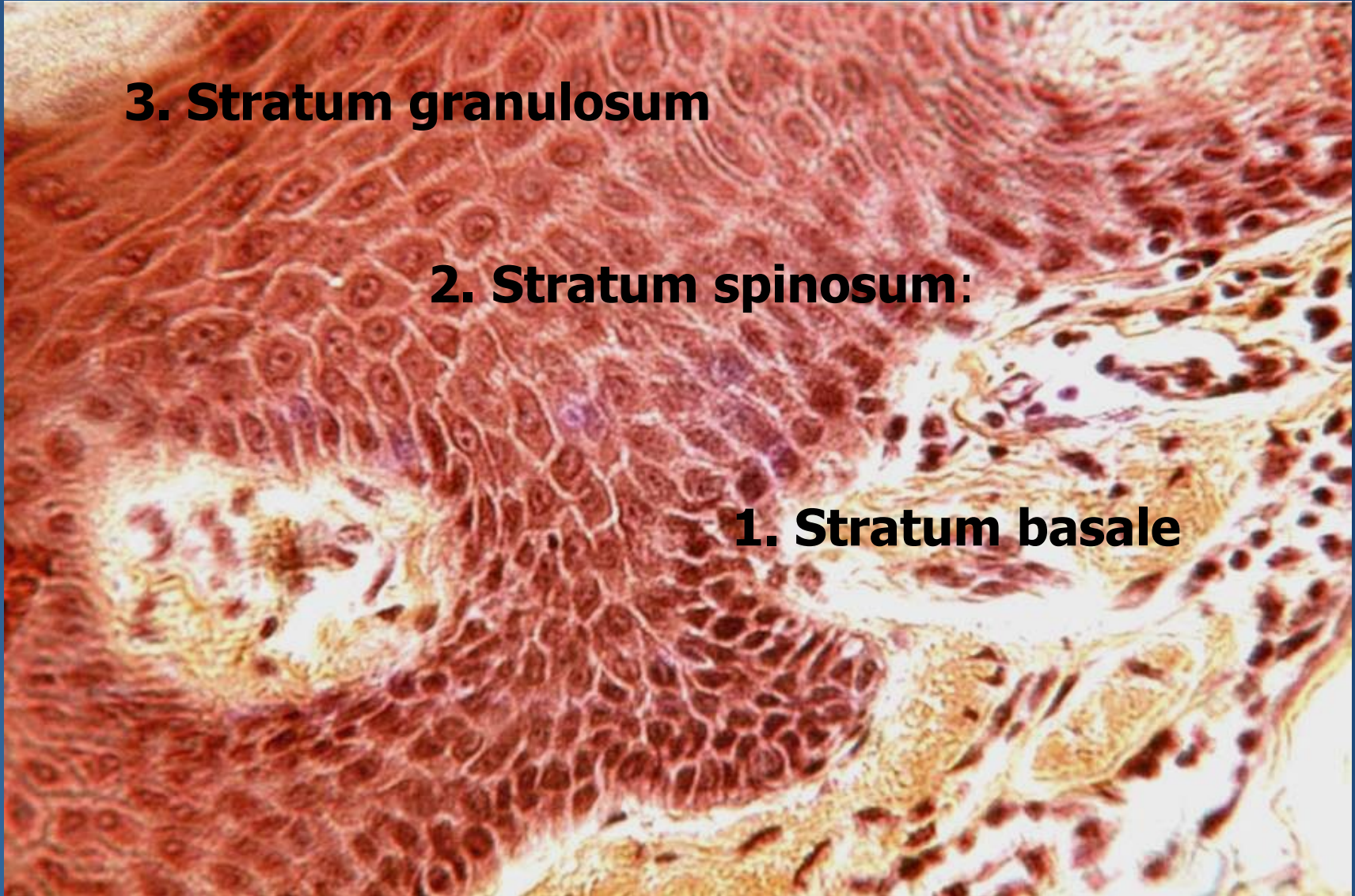
1. Stratum basale (stratum cylindricum):
a single layer of basophilic columnar or cuboidal cells, contain cytokeratin filaments
numerous desmosomes, intense mitotic activity



3. Stratum granulosum

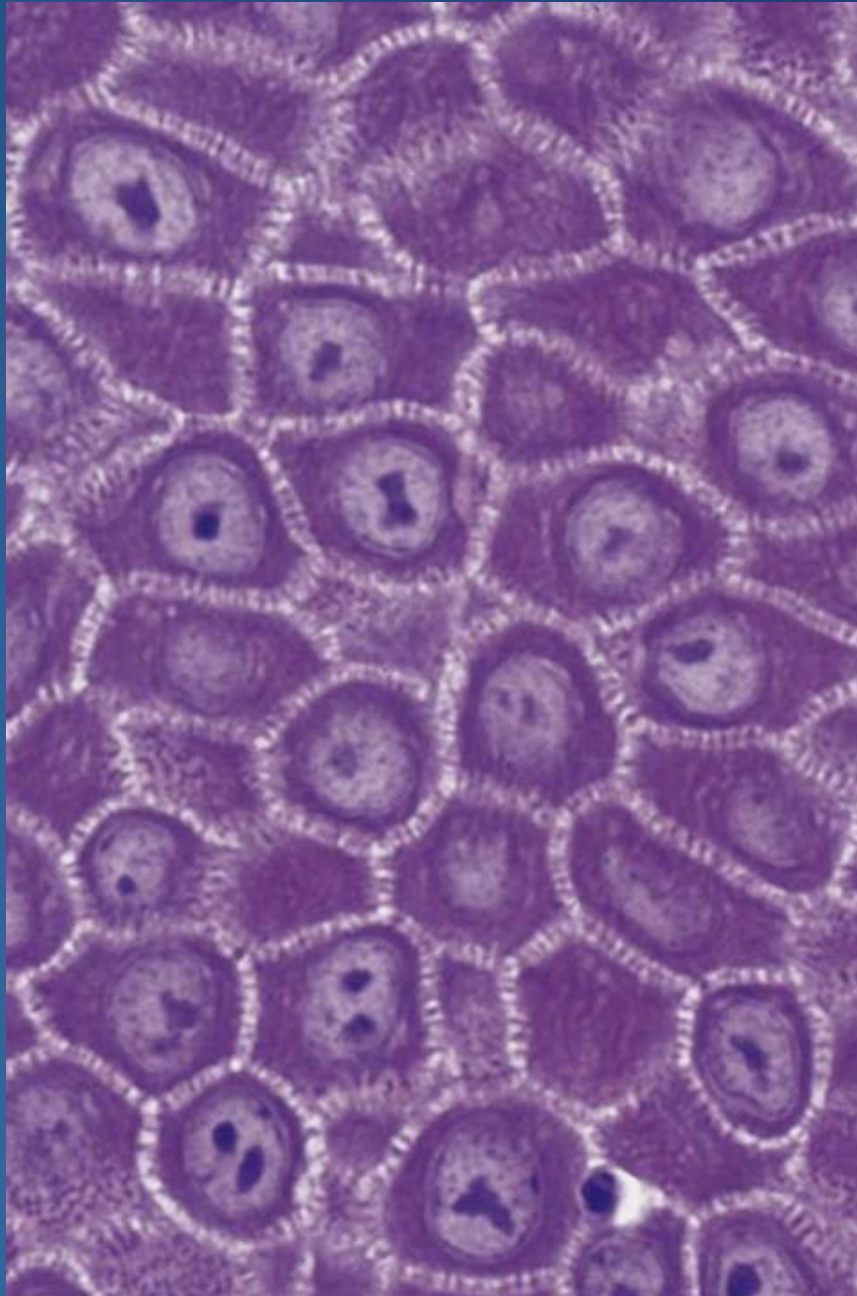
2. Stratum spinosum:

1. Stratum basale

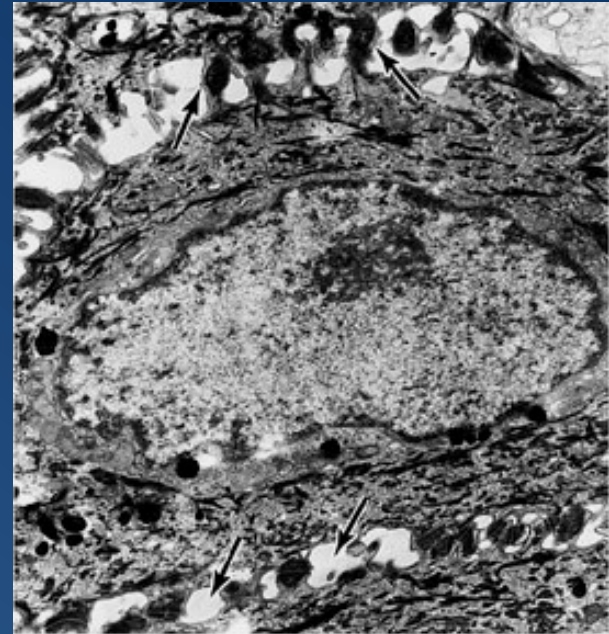


Stratum spinosum:

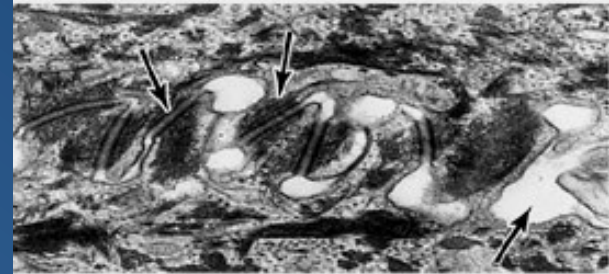
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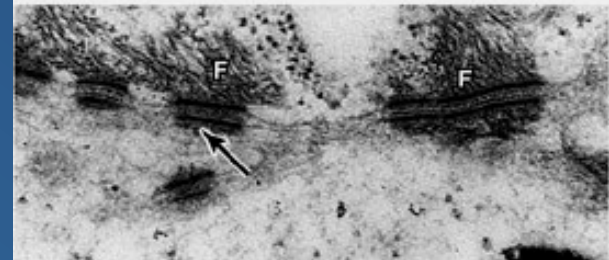
TEM



A



B



C

After keratinisation, the cells consist of only fibrillar and amorphous proteins and thickened plasma membranes

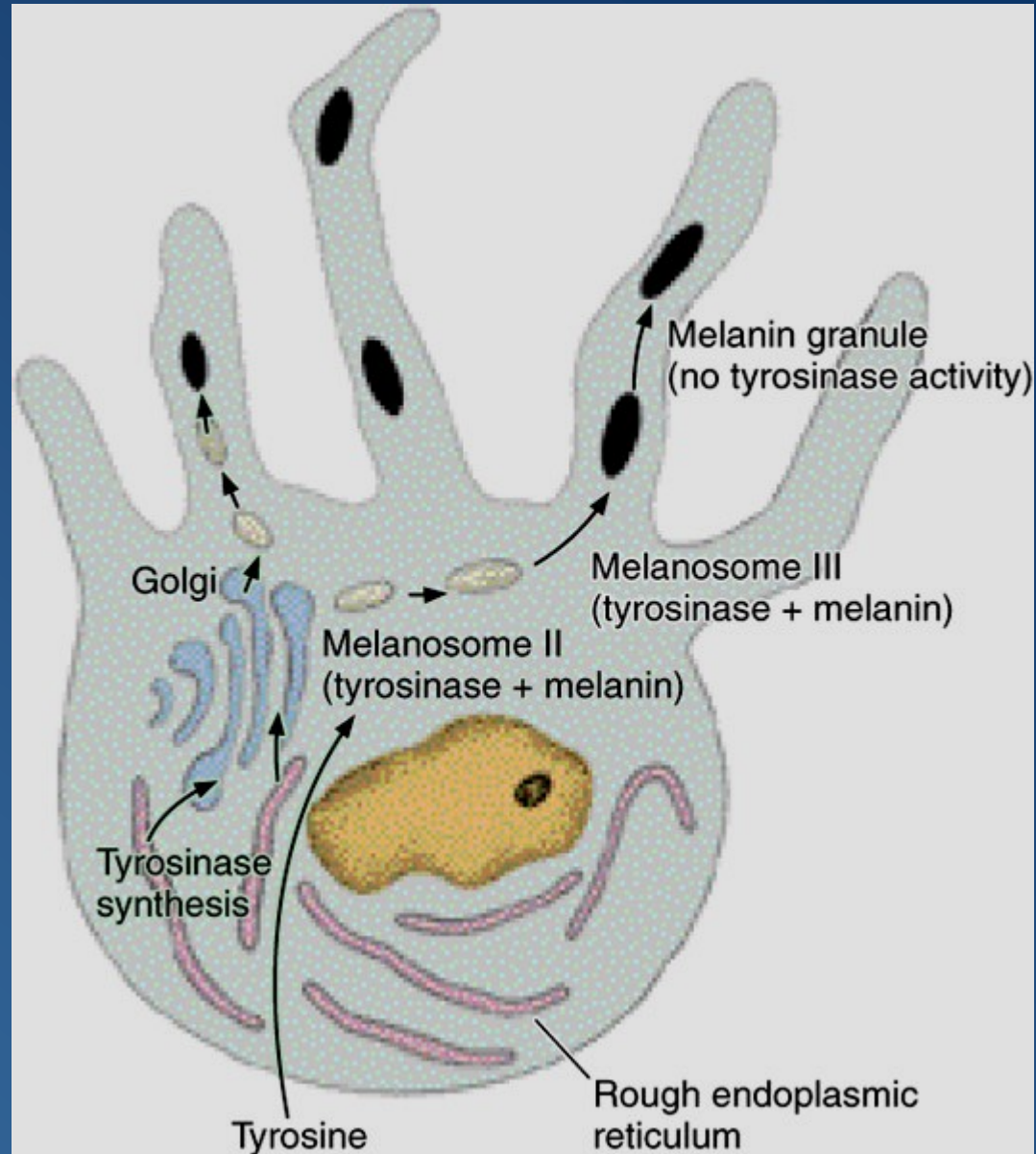
called **horny cells**

Melanocytes

are specialized cells of the epidermis located beneath or between cells of the stratum basale and in hair follicles

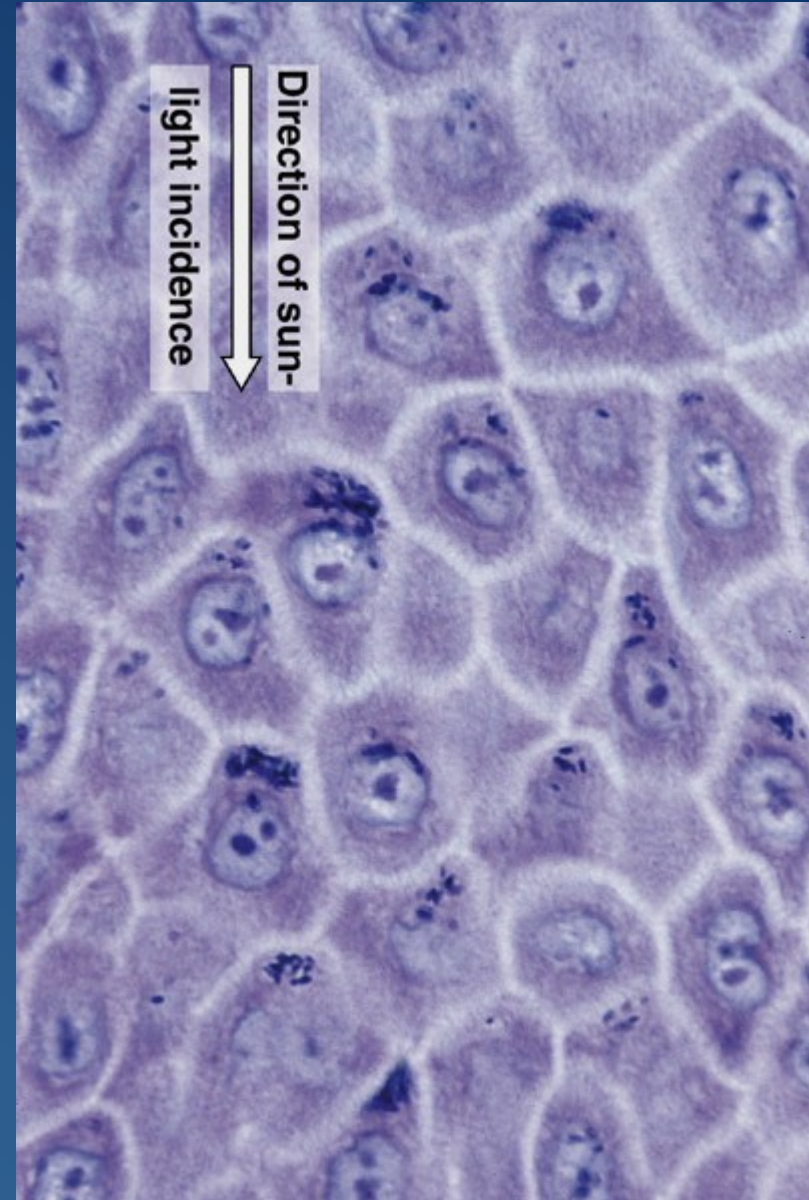
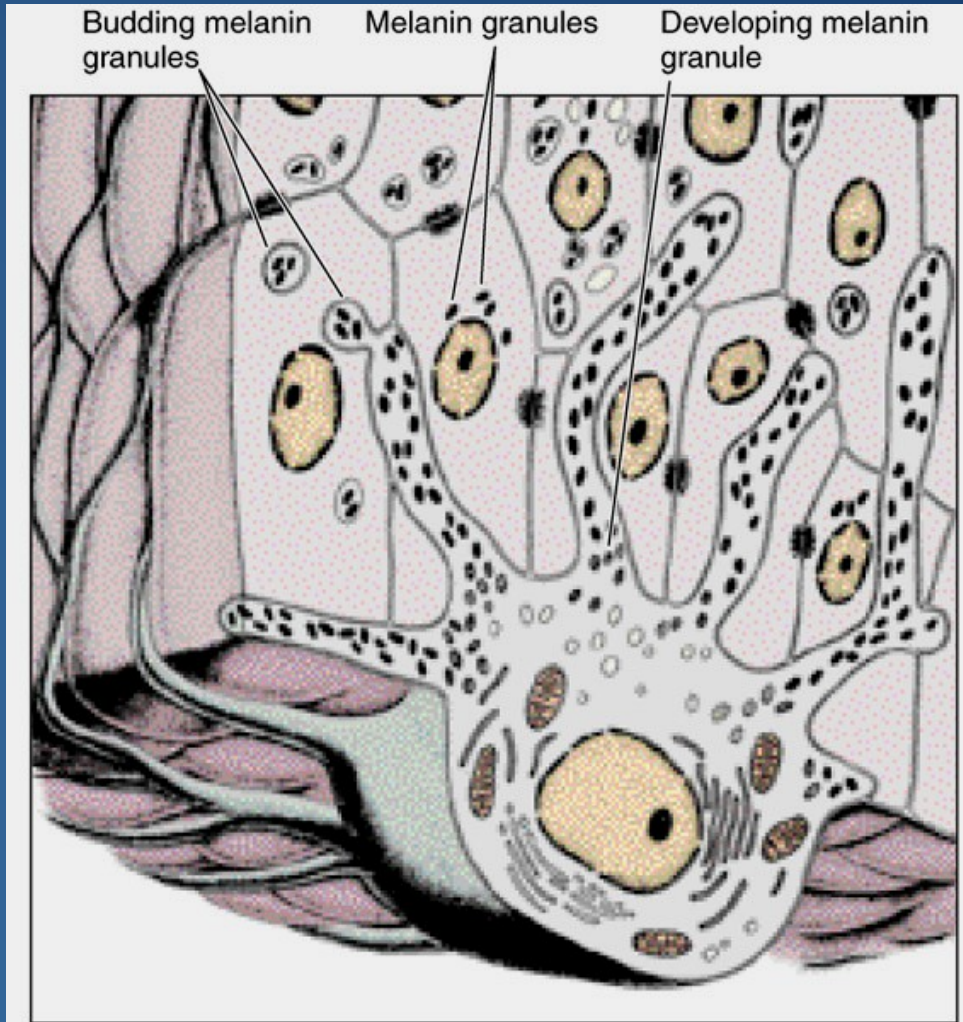
cells synthesize and produce eumelanin

synthesized melanin granules are then injected in the cytoplasm of keratinocytes



the color of the skin results from the content of melanin

supranuclear location of granules



Langerhans cells (dendritic cells)

are star shaped cells, found mainly in the stratum spinosum of the epidermis

2 - 8 % of the epidermal cells

cells are supposed for the bone-marrow-derived macrophages and are capable of binding and presenting antigens to T lymphocytes

Merkel's cells

occur mostly in the thick skin

they resemble keratinocytes but contain small dense granules in the cytoplasm

numerous nerve endings terminate at the base of each Merkel's cell -

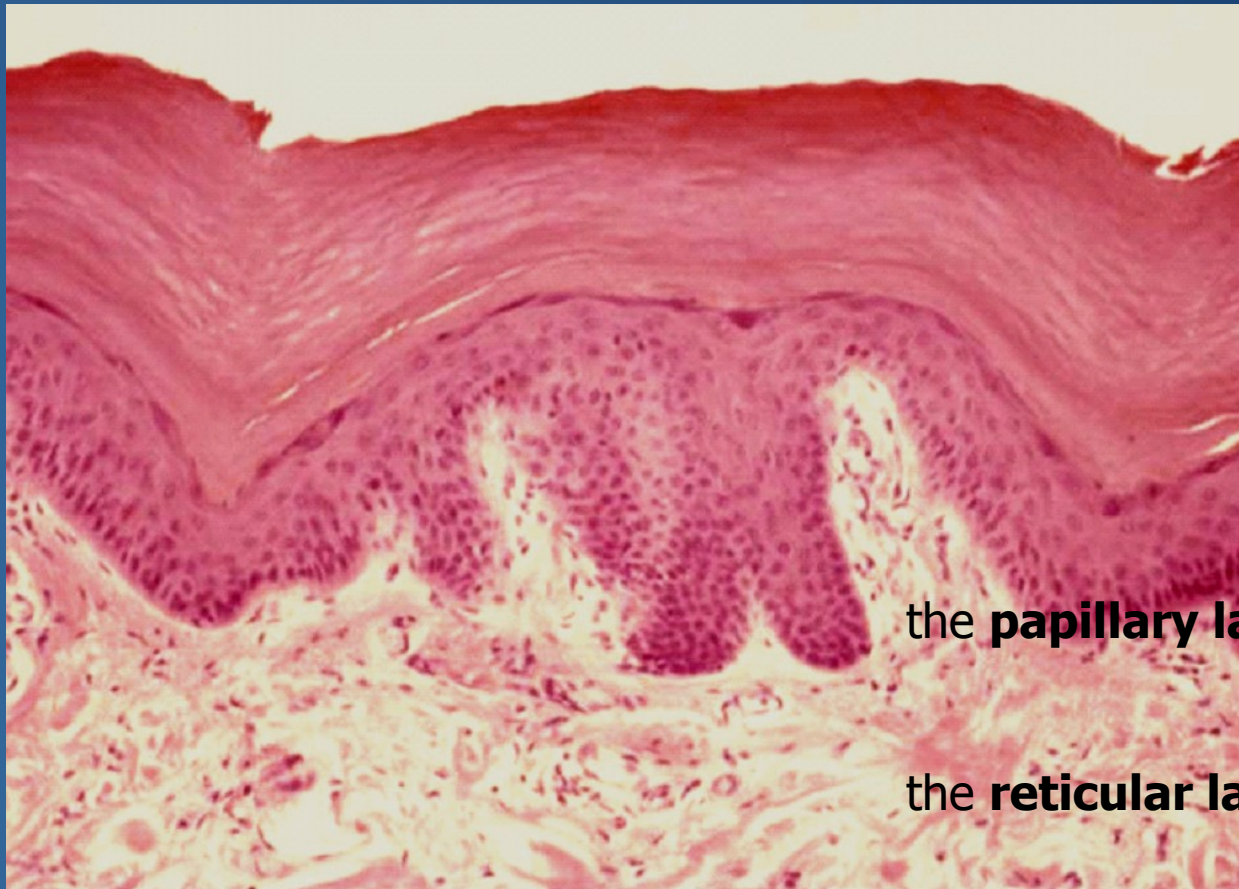
sensory mechanoreceptors

DERMIS

it supports the epidermis and reaches the thickness about 4 mm

2 layers with rather indistinct boundaries:

- the outermost **papillary layer** (stratum papillare corii) - of loose connective tissue with networks of elastic and reticular fibers
- the deeper **reticular layer** (stratum reticulare corii) - of irregular dense connective tissue (collagen I)
the principal glycosaminoglycan of the dermis is dermatan sulfate

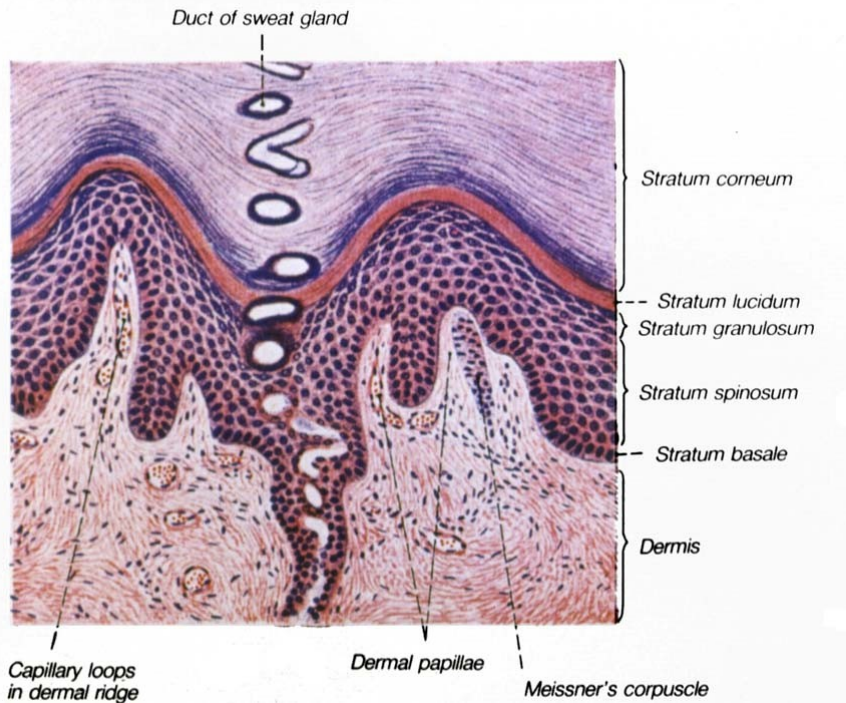
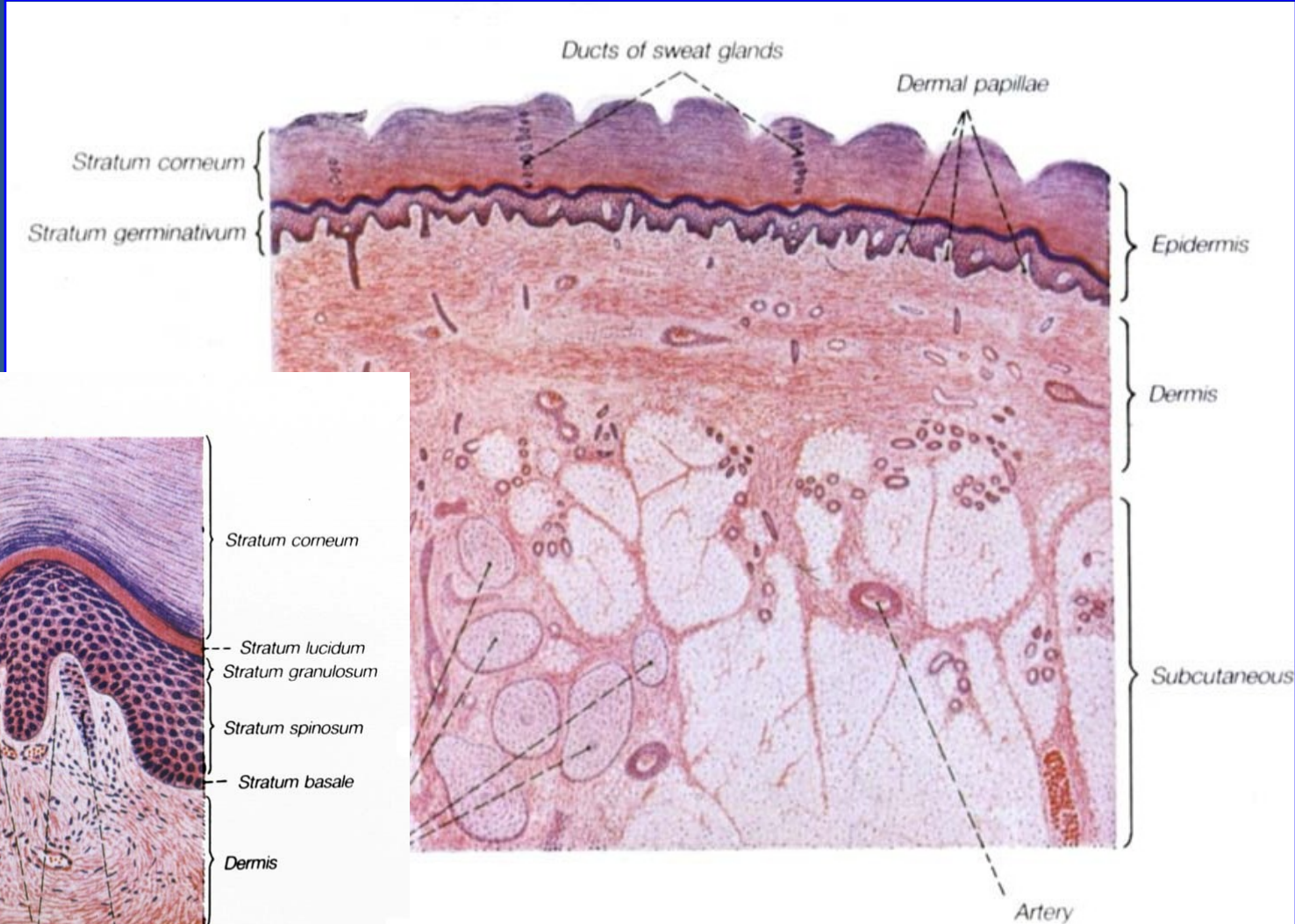


the **papillary layer**

the **reticular layer**

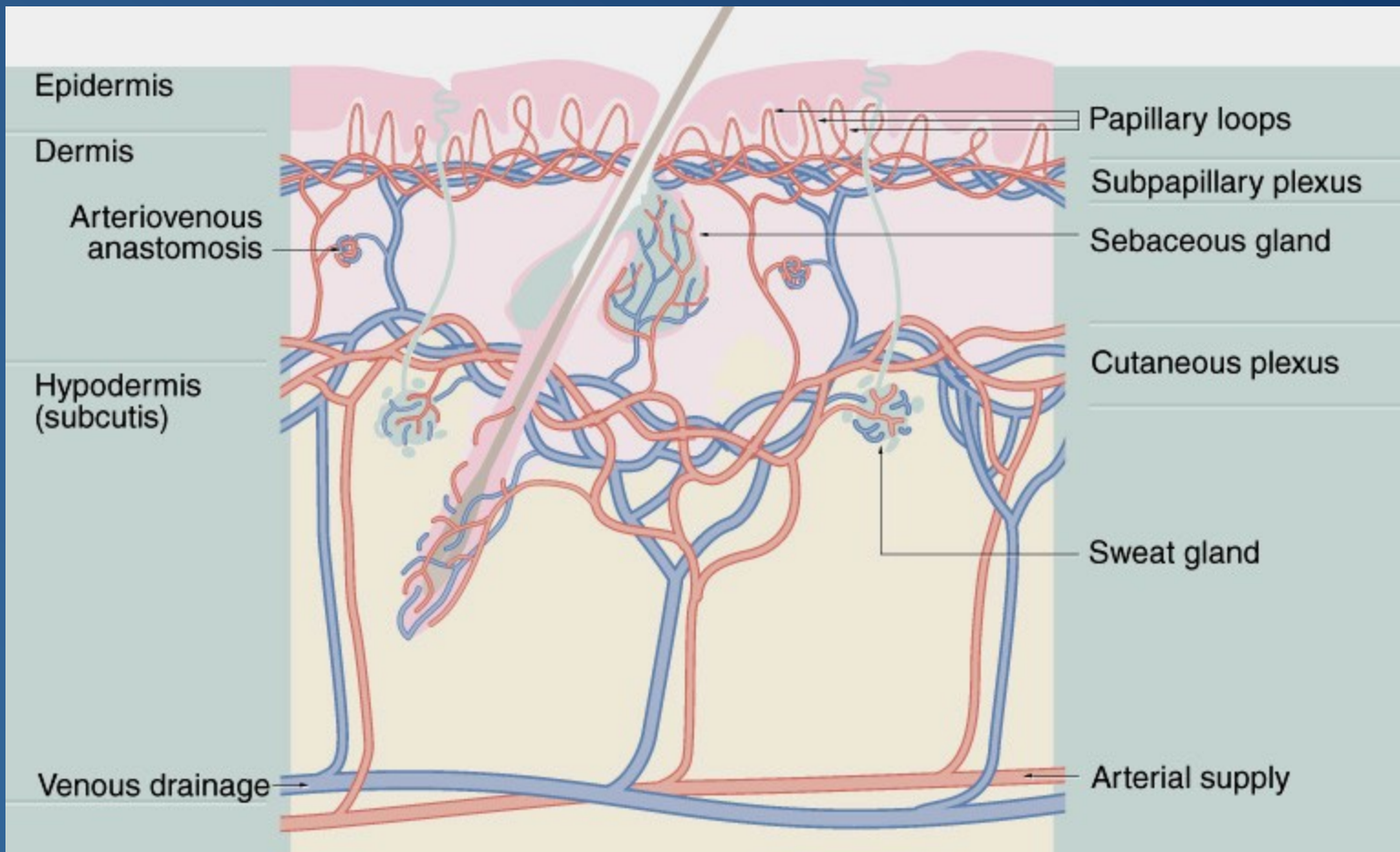
in the **thick (glabrous) skin** found on palms and soles **dermal papillae run in pairs**
 they are supported with **common corial ridges**
 corial ridges correspond to the **cristae cutis** limited by sulci cutis on the surface of the epidermis
 orientation of cristae cutis is unique for each individual

dactyloscopy



the dermis has a rich network of blood and lymph vessels
blood may pass through capillaries or directly from arteries to veins via arteriovenous anastomoses or shunts

these play a very important role in temperature and blood pressure regulation

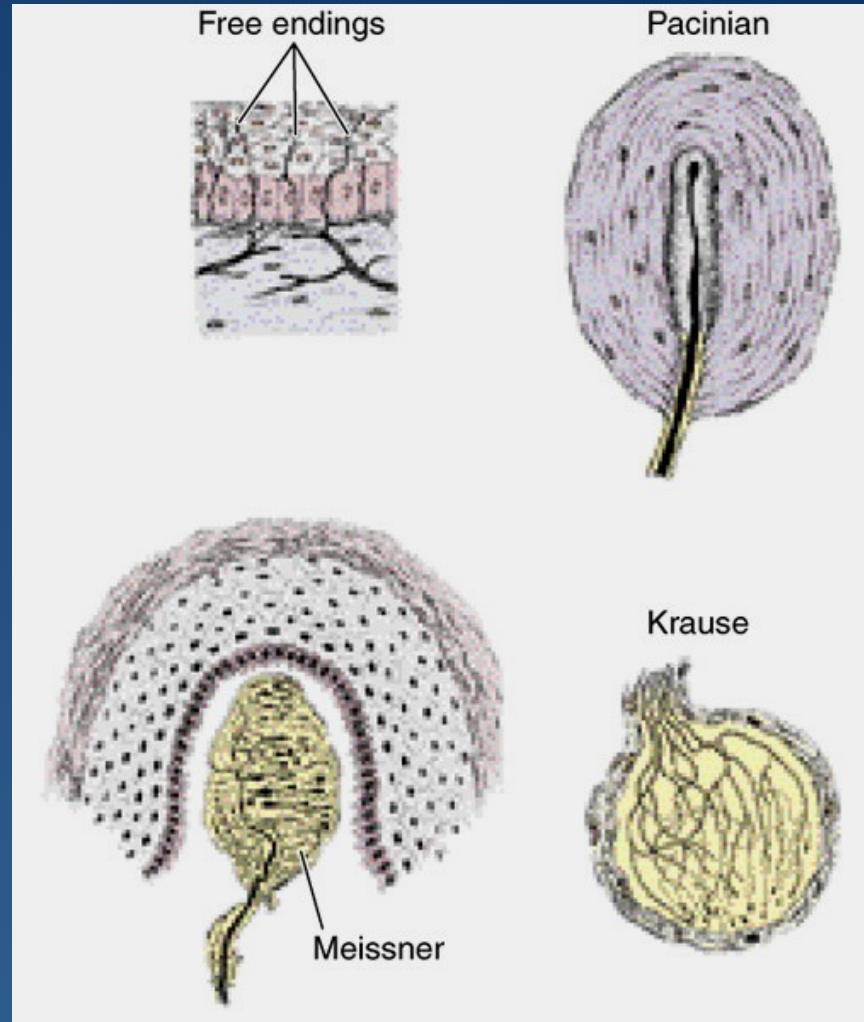


nerve supply of the skin is very rich

SUBCUTANEOUS TISSUE
(hypodermis, tela subcutanea)

consists of loose connective tissue that binds the skin loosely to the subjacent organs (muscles, perichondrium or periosteum)

it may contain fat cells



Skin derivatives of glandular type

glands of the skin are of 2 types:

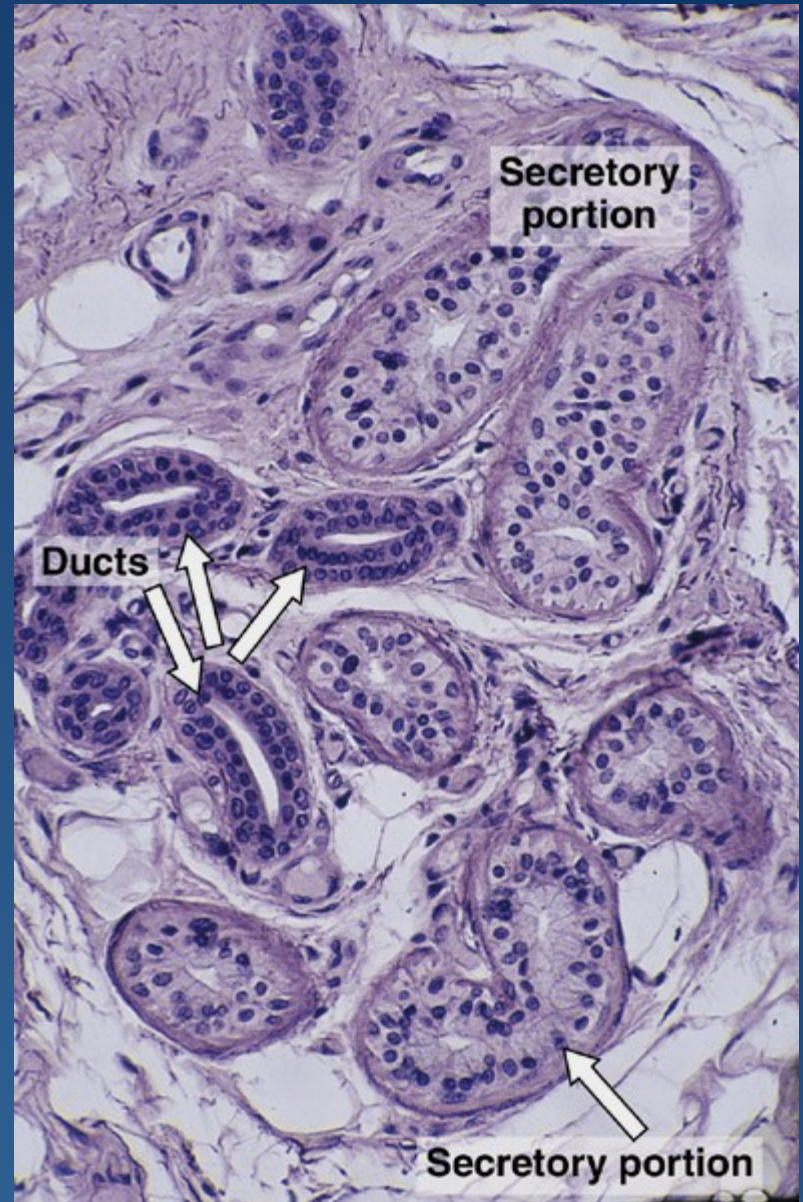
- **sweat glands**
- **sebaceous glands**

Sweat glands - widely distributed throughout the body, are specialized for production of sweat that cools the body by evaporation, and other complex secretions

eccrine sweat glands (*gll. sudoriparae*, *gll. globiformes*)

are found everywhere on the body surface except the free margin of the lip, the prepuce and glans penis, the clitoris, and labia minora

glands are simple, coiled tubular
consist of: the **secretory portion**
 the **duct**



the **secretory portion**: the thick basement membrane, myoepithelial cells and secretory cells:

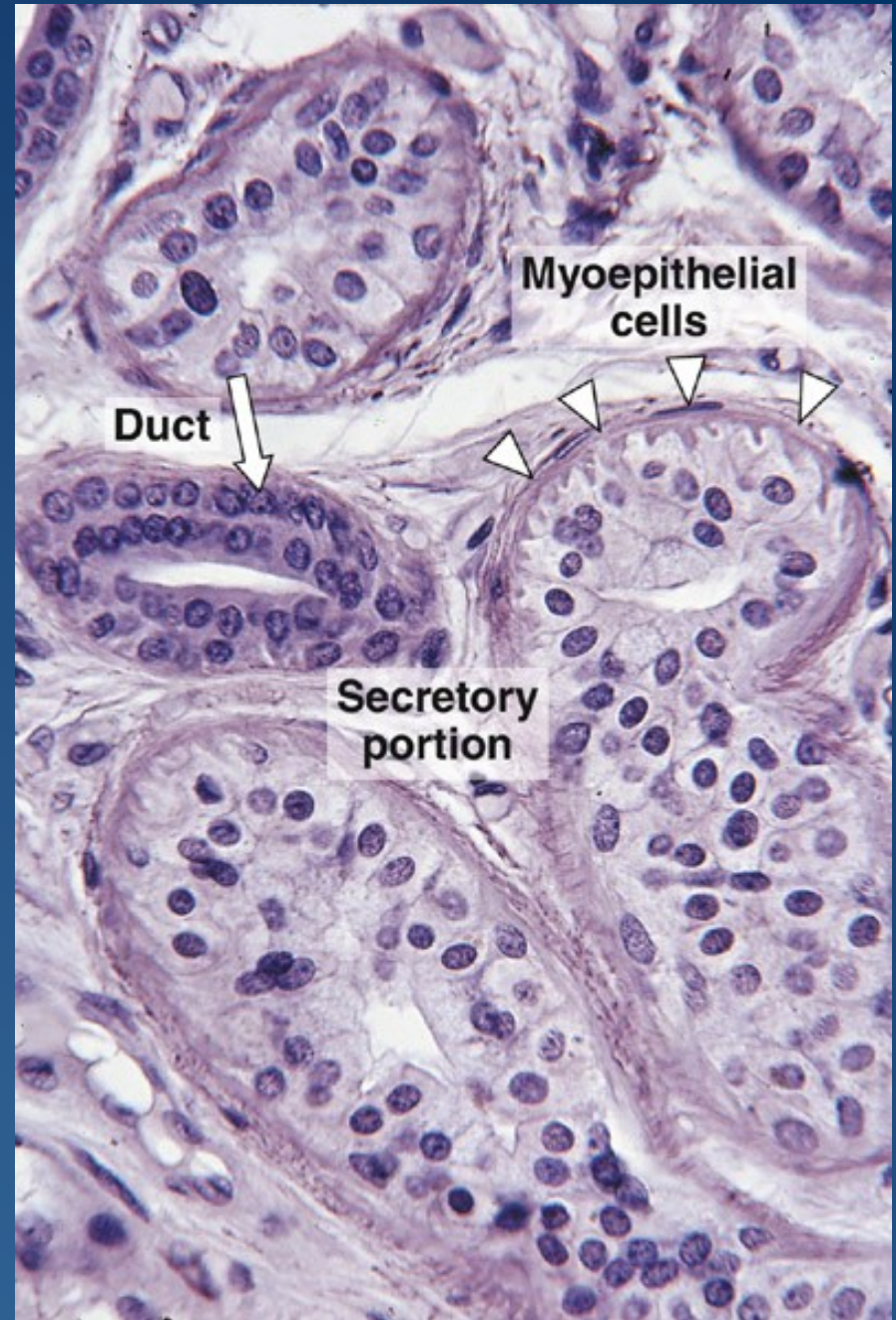
dark cells (mucoïd cells) are pyramidal cells with basophilic cytoplasm granules contain glycoproteins

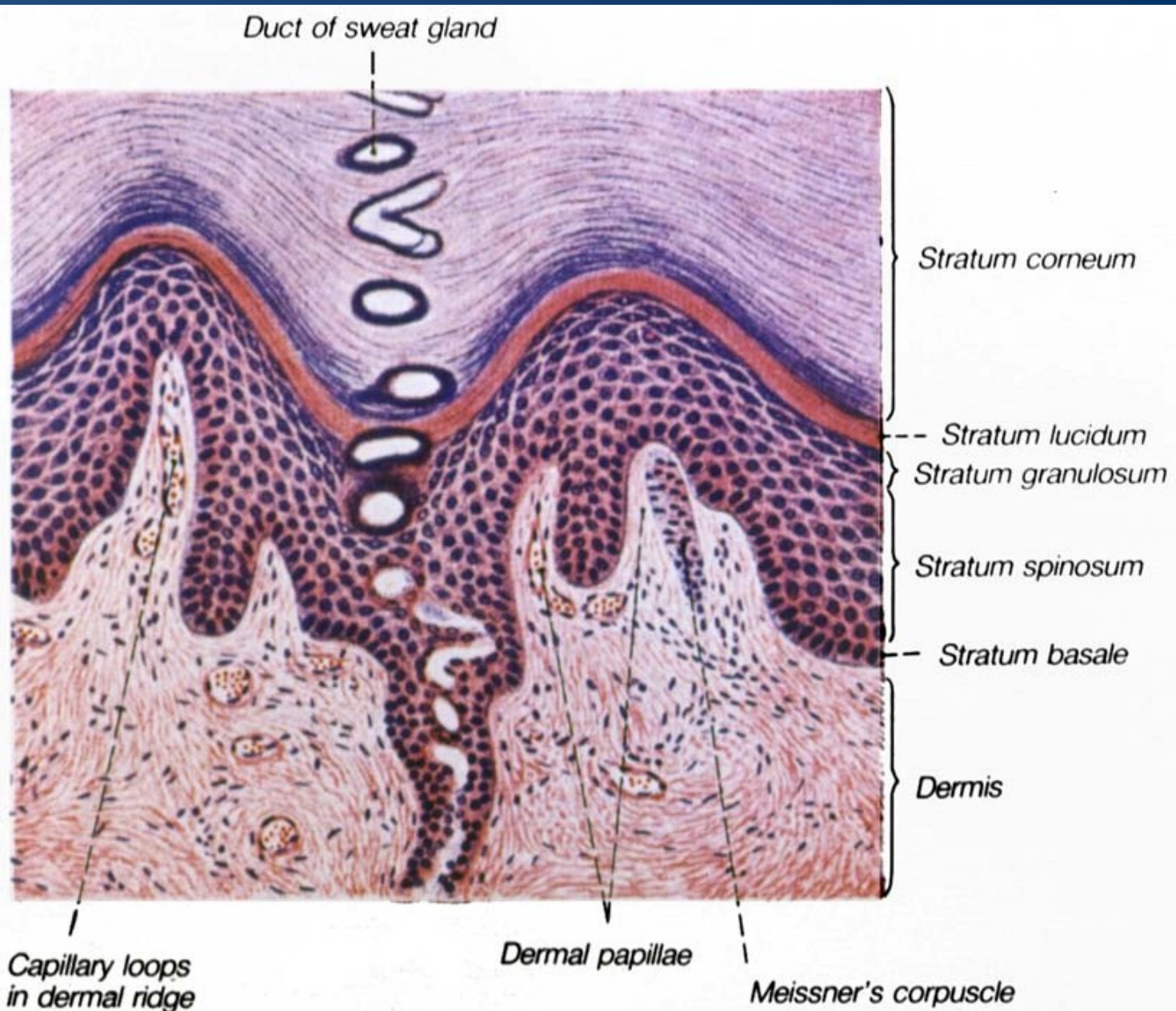
clear cells are devoid secretory granules but contain an abundance of glycogen particles

the **duct**:

a) **proper duct** - in the dermis, its wall is composed of two-layered epithelium, myoepithelial cells and the basement membrane

b) **intraepidermal canaliculus** - located in the epidermis it has no proper wall





secretion of eccrine glands is not viscous and contains little protein, components are **water, sodium chloride, urea, ammonia, and uric acid**

apocrine sweat glands

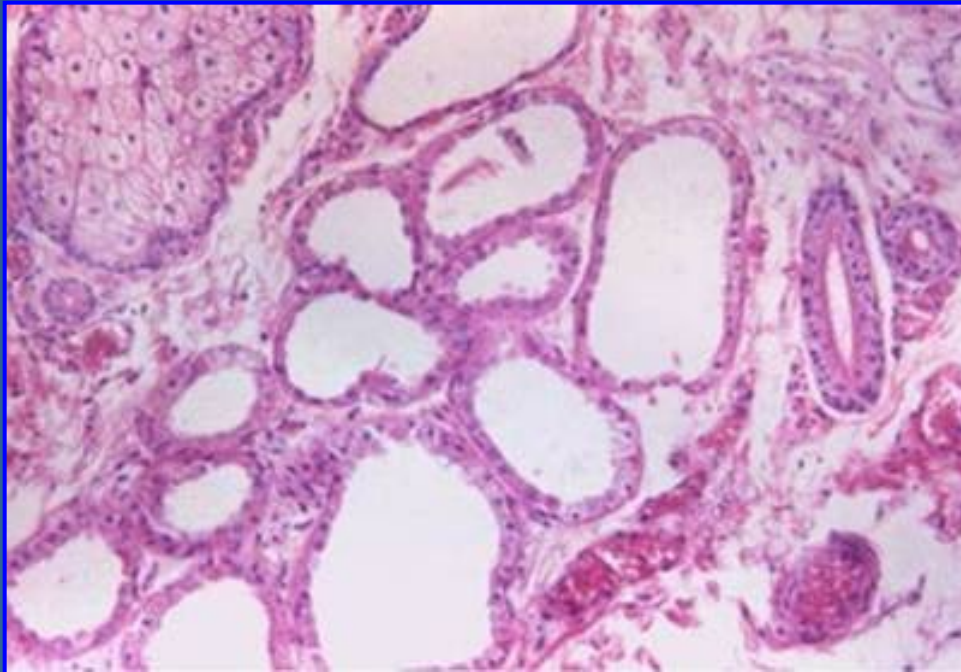
in the axillary and anal regions

the **secretory part** that is much larger than that in eccrine sweat glands and is lined by a cuboidal or columnar eosinophilic secretory cells

the **duct** that opens into hair follicle

glands produce a viscous milky white odorous secretion

apocrine glands start secretion after puberty, under influence of sex steroids



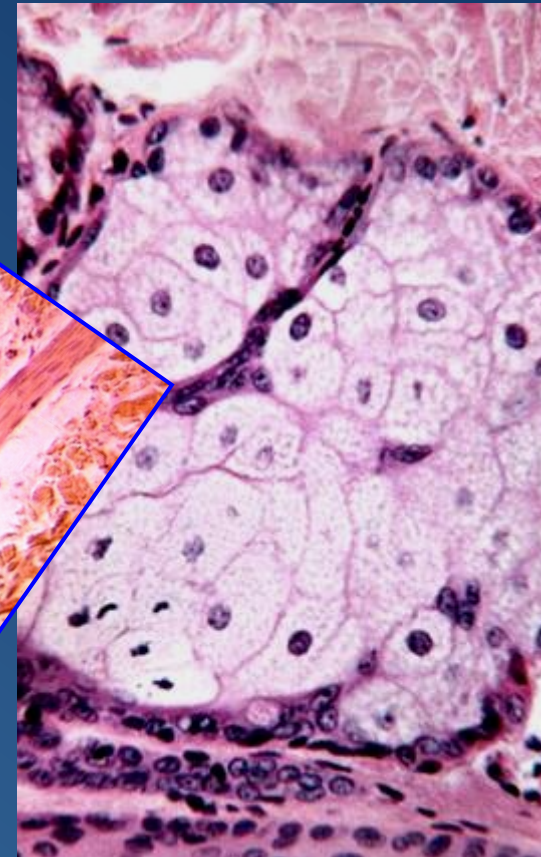
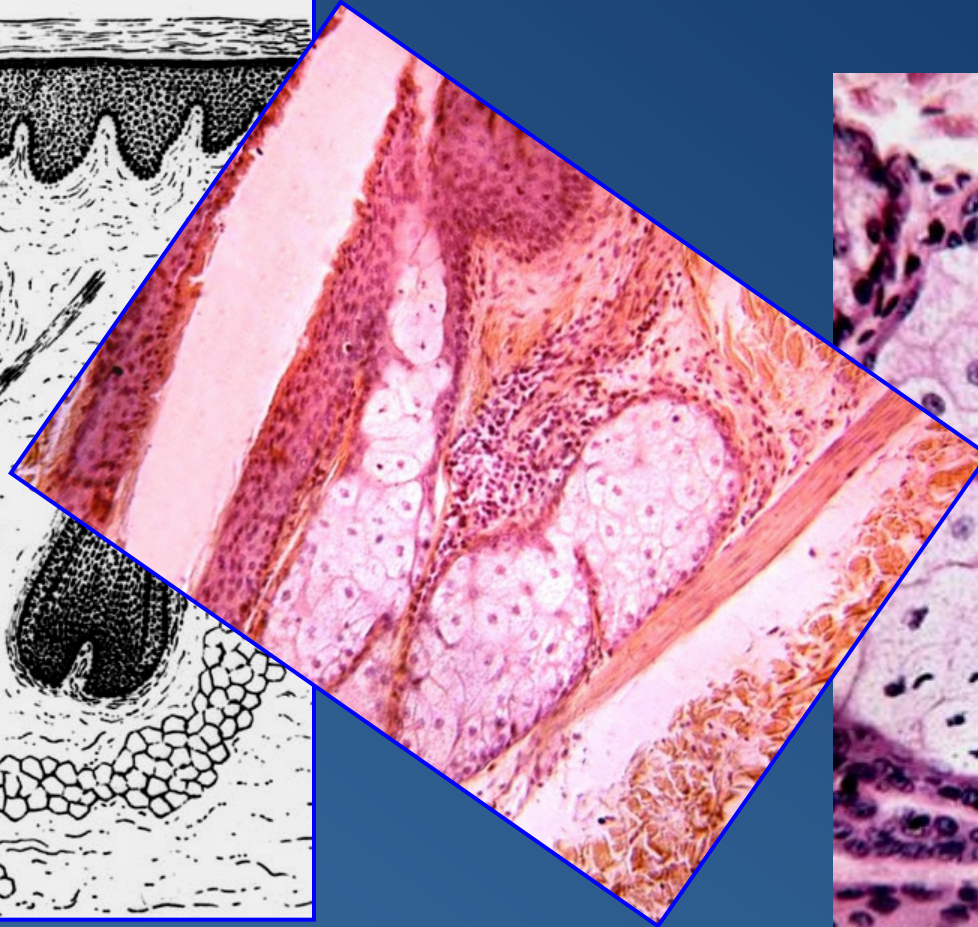
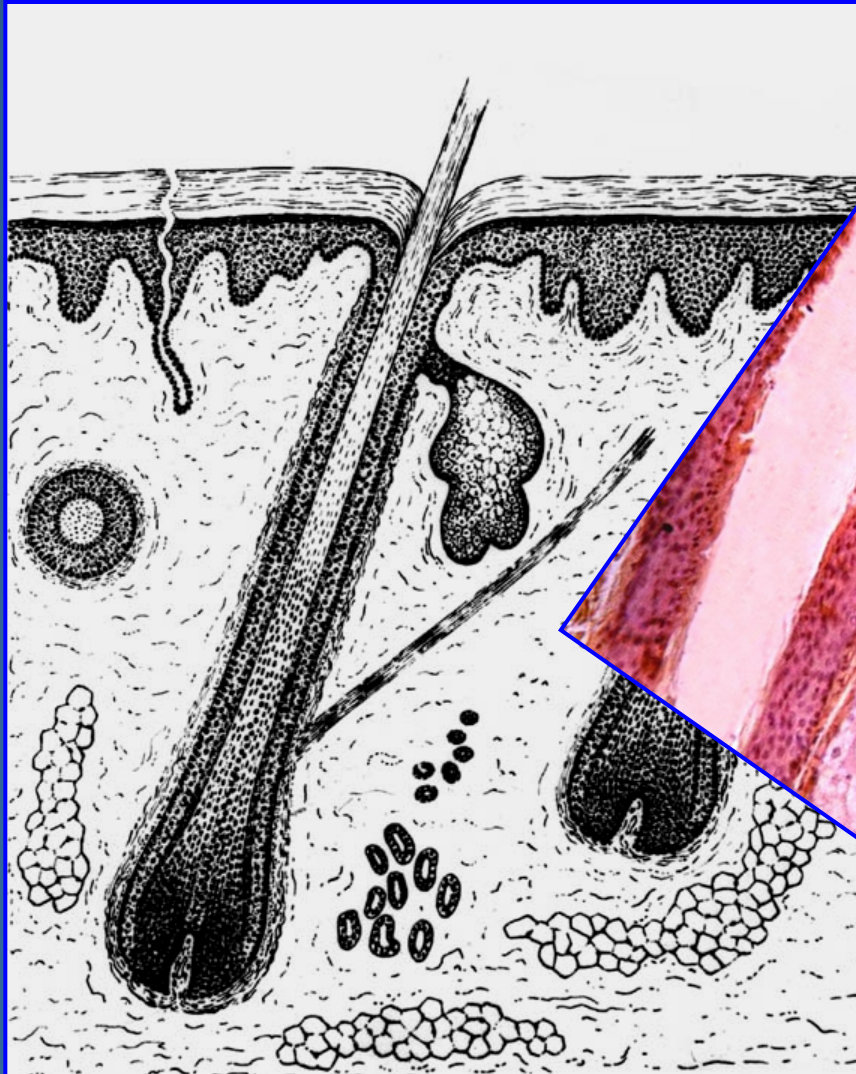
modified apocrine sweat glands: the **ceruminous glands** in the external auditory meatus, **glands of Montgomery** in the nipple, and **glands of Moll** in eyelids

Sebaceous glands

are **holocrine type** and are associated with **hair follicles**

they occur practically on all body surfaces except the palms of the hands and soles of the feet

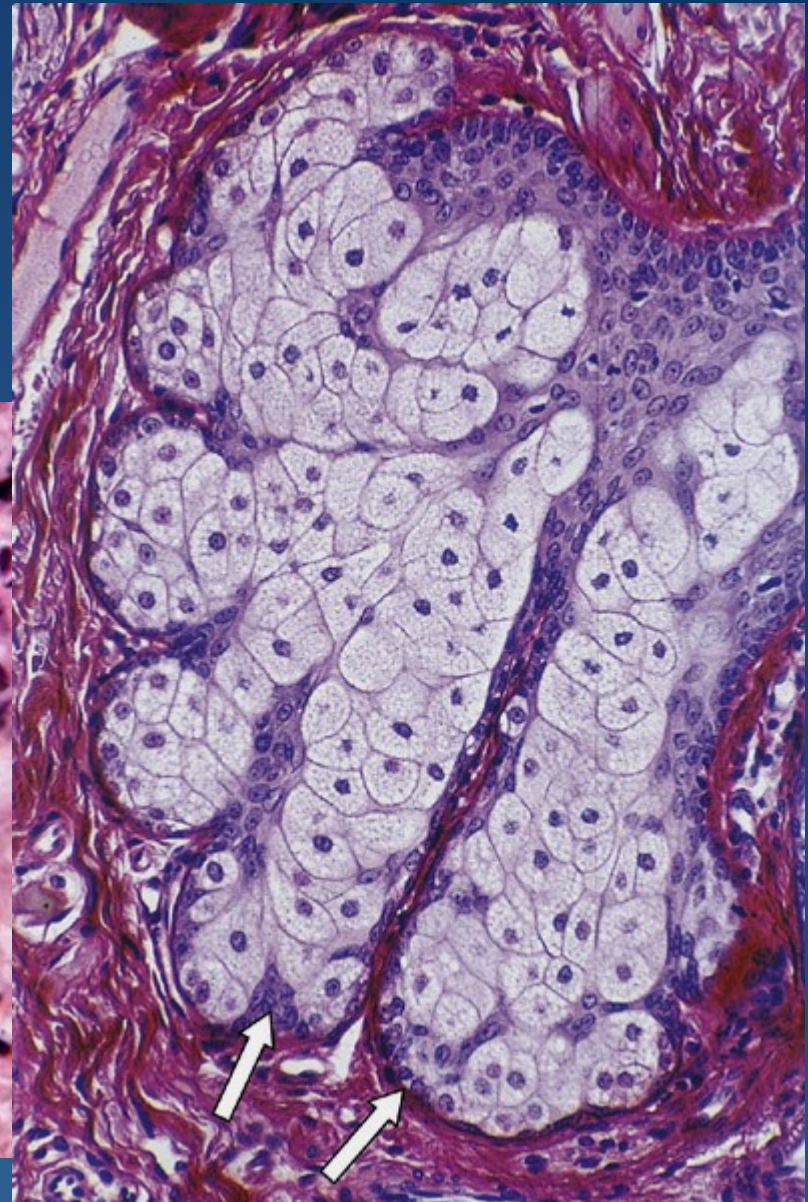
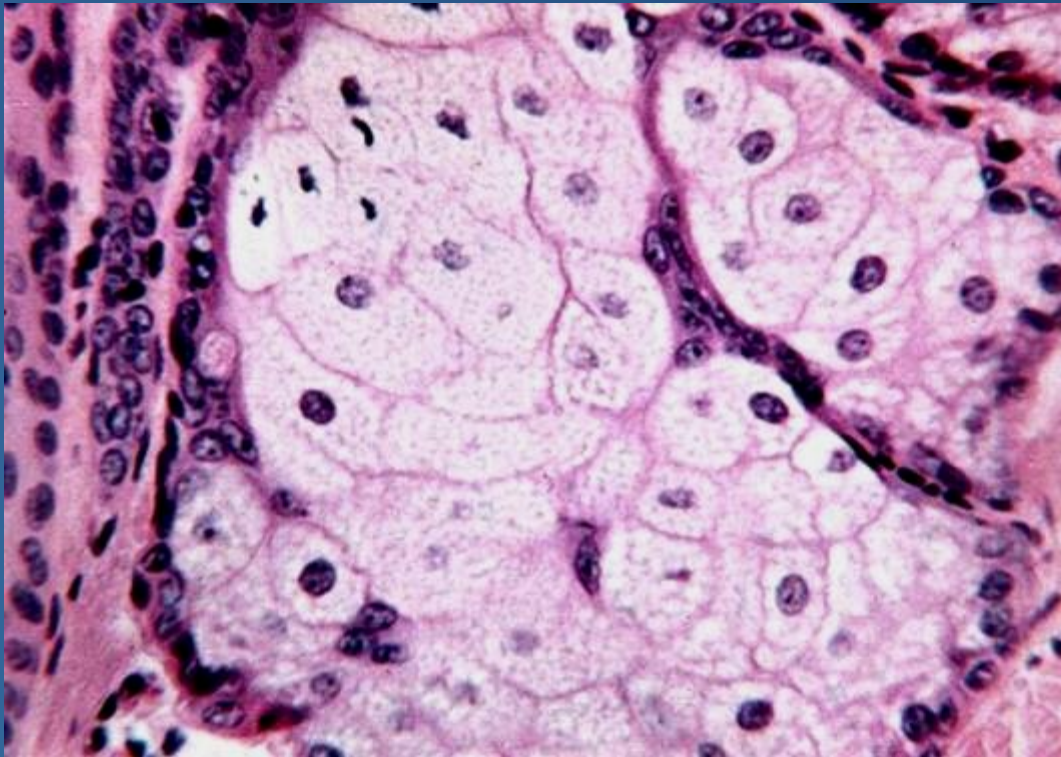
consists of several **alveoli (acini)** and **short duct** that opens in the **upper portion of a hair follicle** and is lined by a stratified squamous epithelium



acini are composed of two types of cells:
an outer layer of **stem cells** called basal cells and
central group of cells that accumulate lipid droplets in their
cytoplasm

central cells disintegrate and become a
part of sebum (holocrine secretion)

**sebaceous glands begin to function
at puberty**



Skin derivatives of keratinized type

hairs, nails

hairs - elongated keratinised fibers derived from invaginations of epidermal epithelium, occur everywhere on the body except the palms, soles, lips, glans penis, clitoris, and labia minora

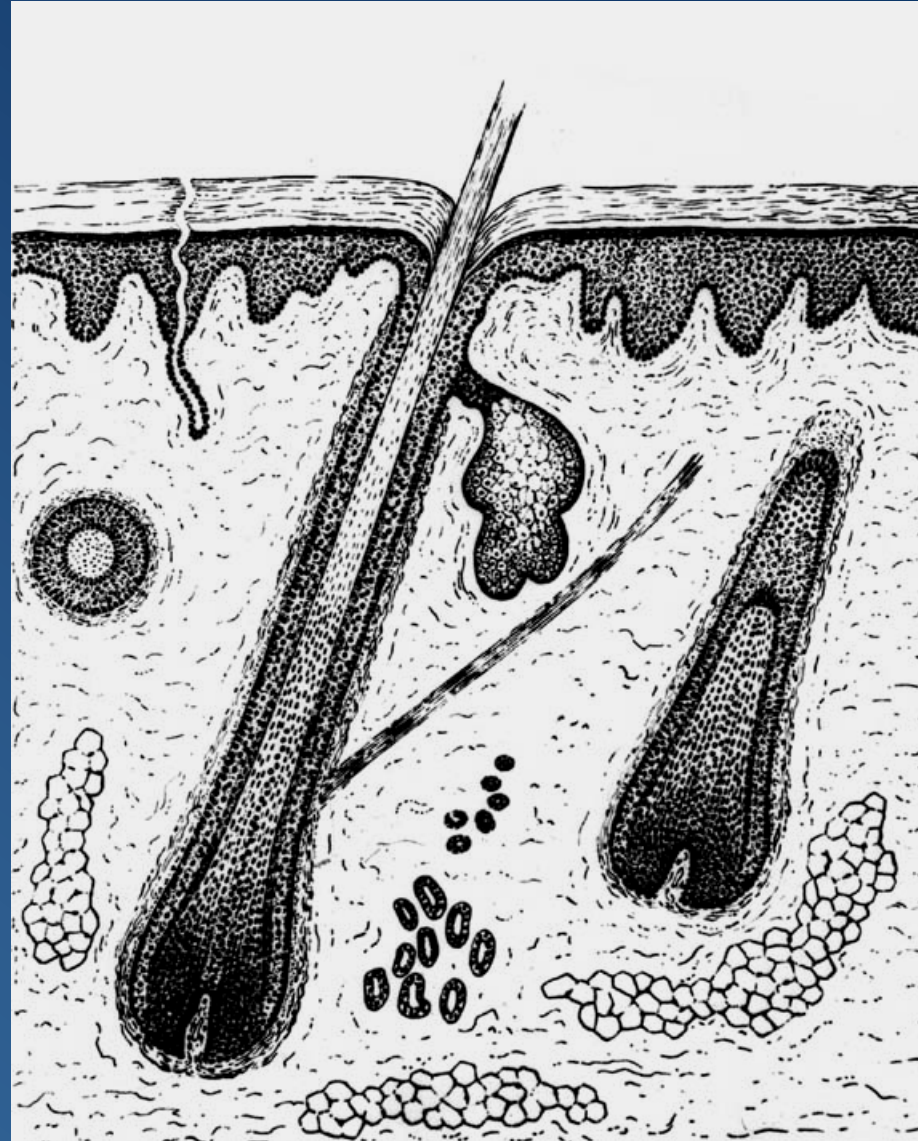
hair consists of

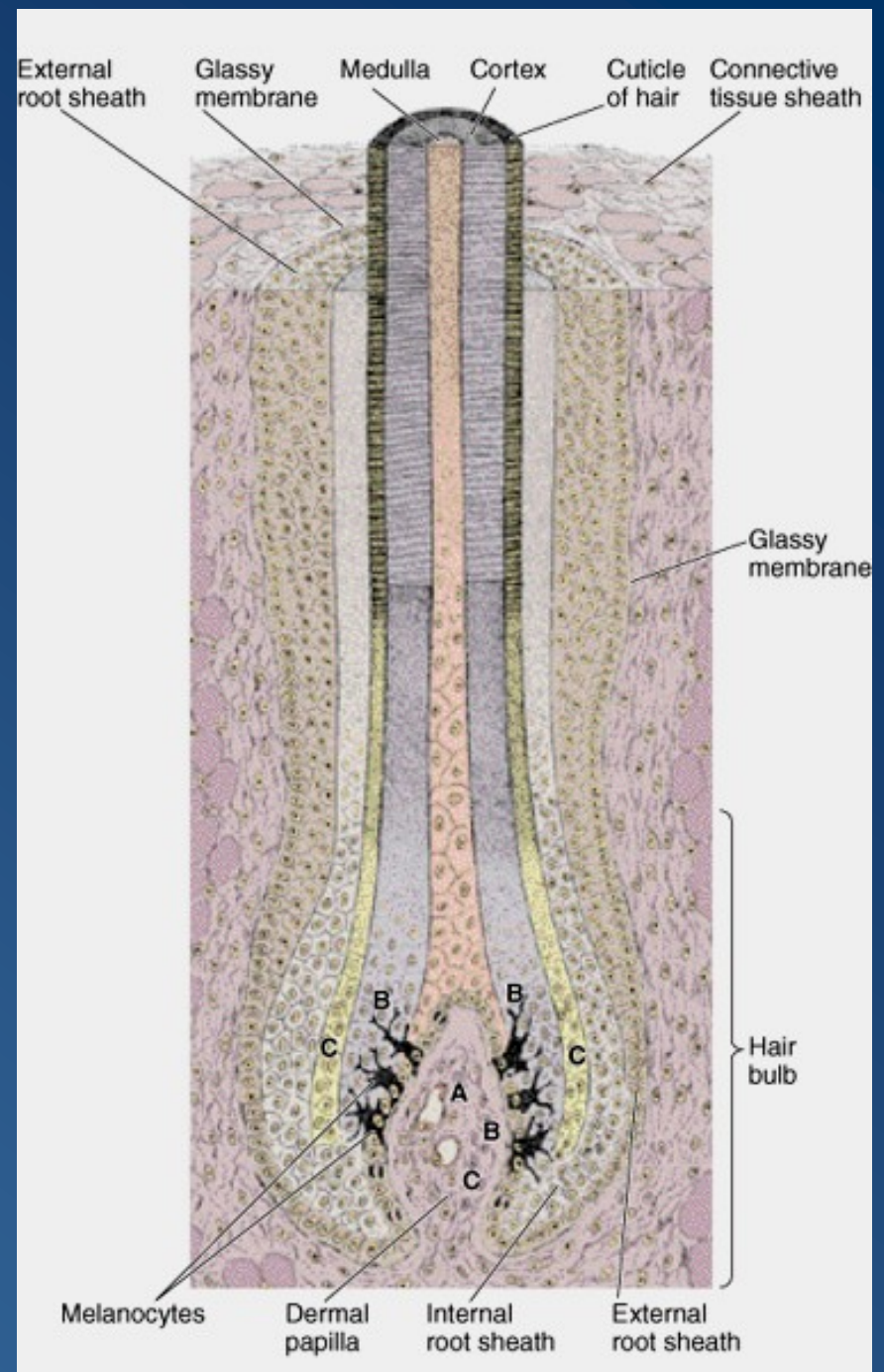
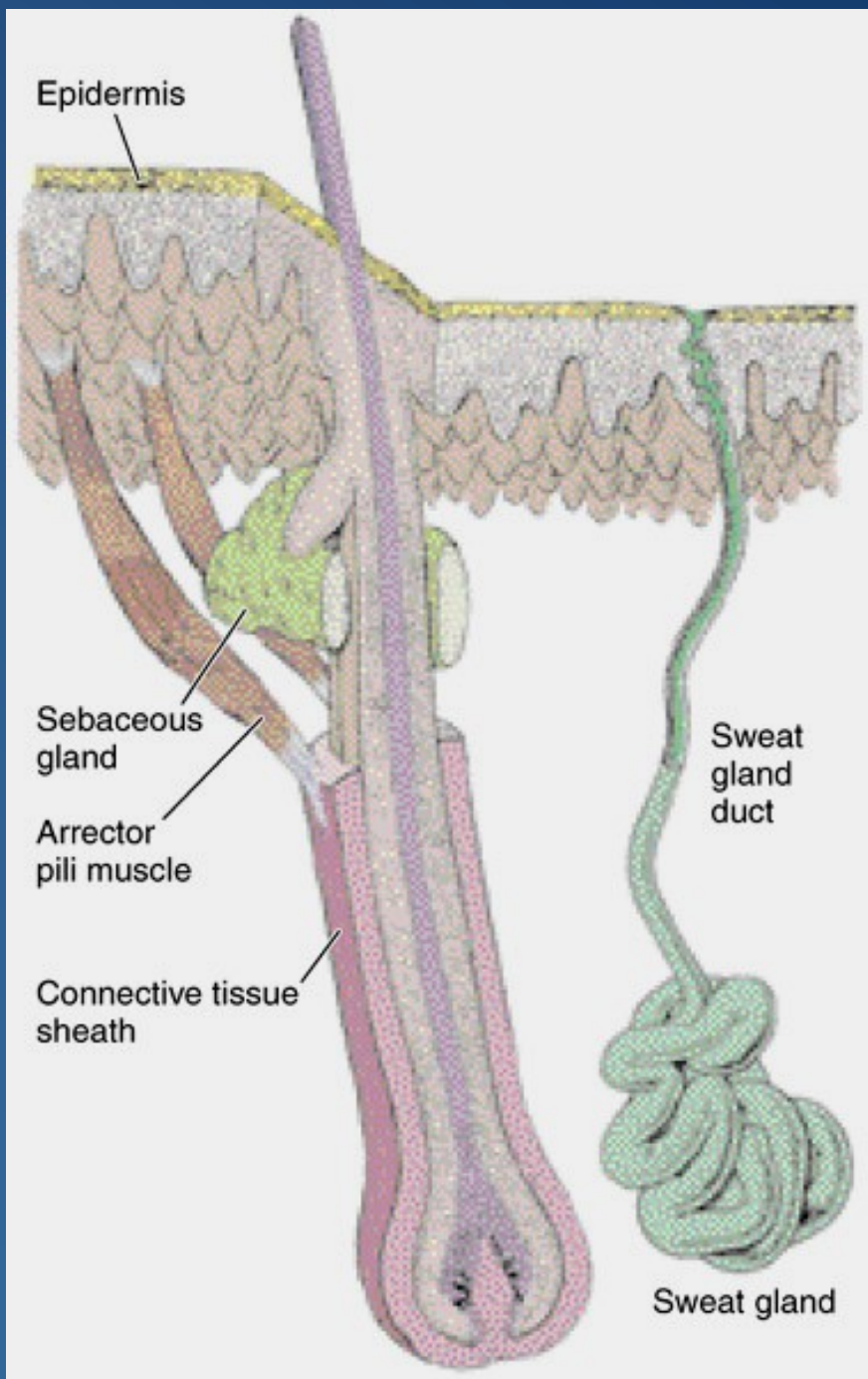
- **free part (scapus pili)** and
- **hair root (radix pili)** - an

extended part of the hair root is

hair bulb

- **hair papilla** formed by vascularized loose connective tissue
- **hair follicle**





Components of the hair

- the hair **medulla** - central part consisting of 2 to 3 rows (columns) of lightly stained, polyhedral cells, it is discernible only in the hair bulb and in thick hairs,
- the hair **cortex** - several layers of spindle-shaped (fusiform), tightly packed cells with melanin granules,
- the hair **cuticle** (epidermicule) - is a layer of single keratinised cells that overlap each other and whose the ends are directed towards the scapus pili

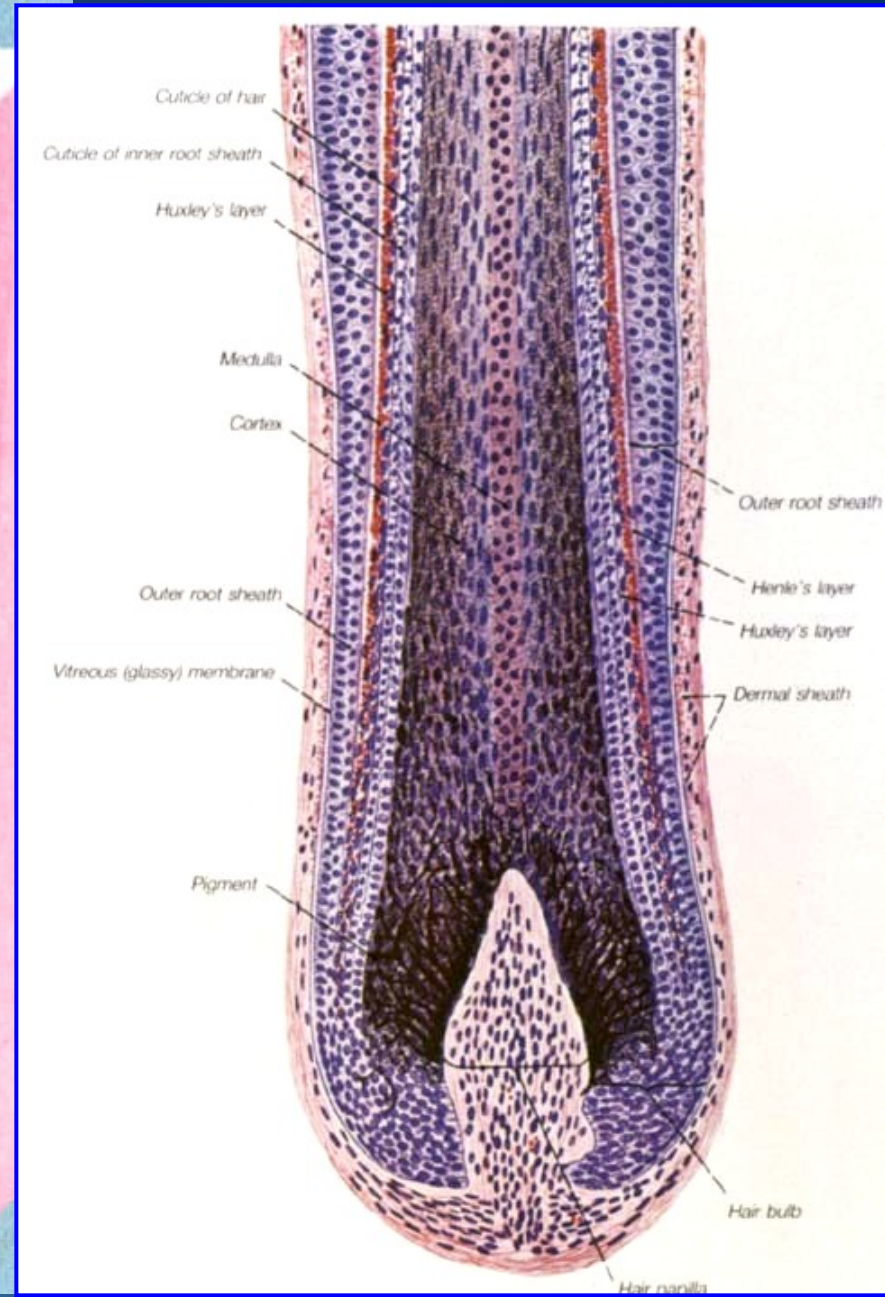
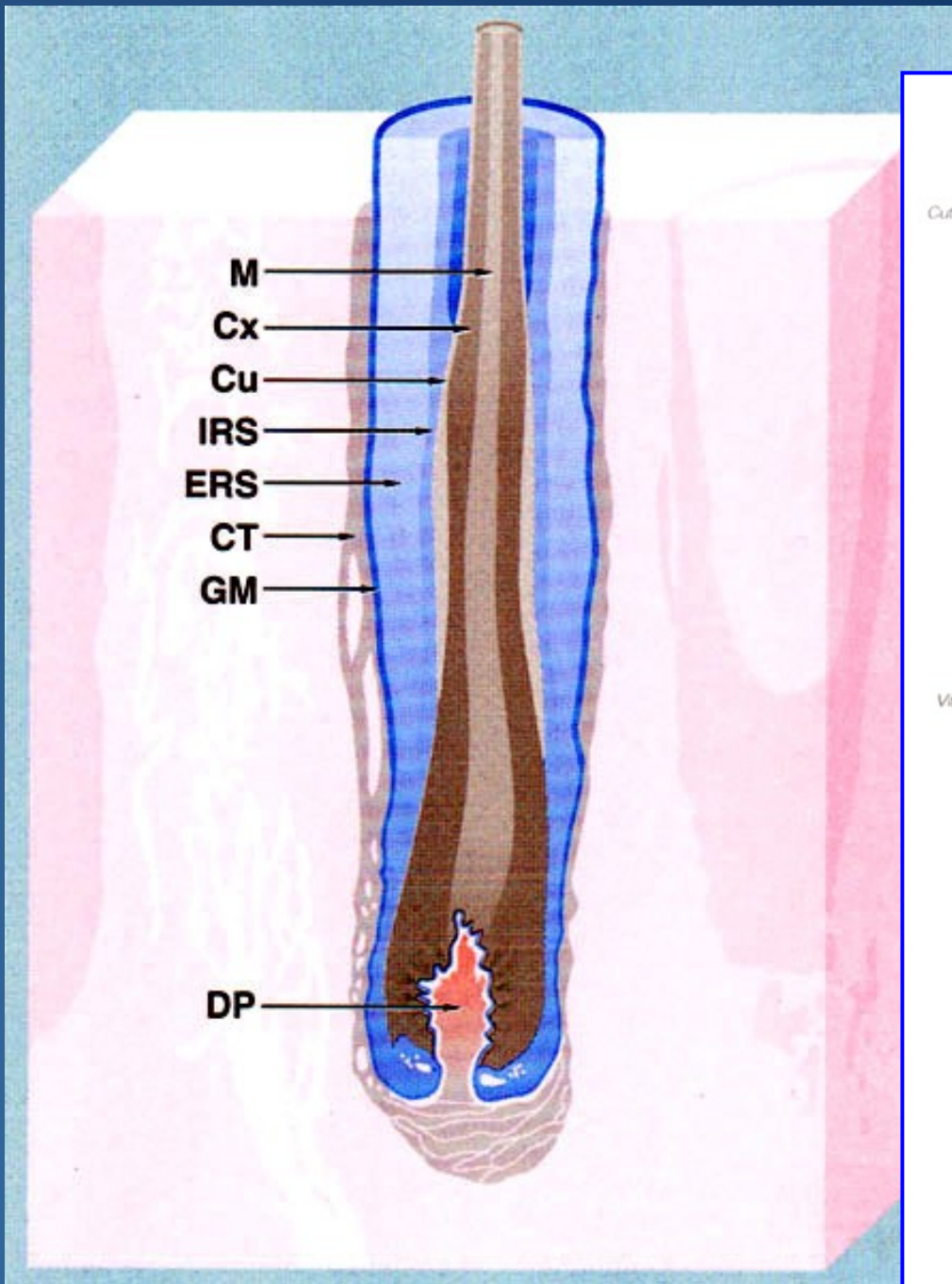
Hair follicle

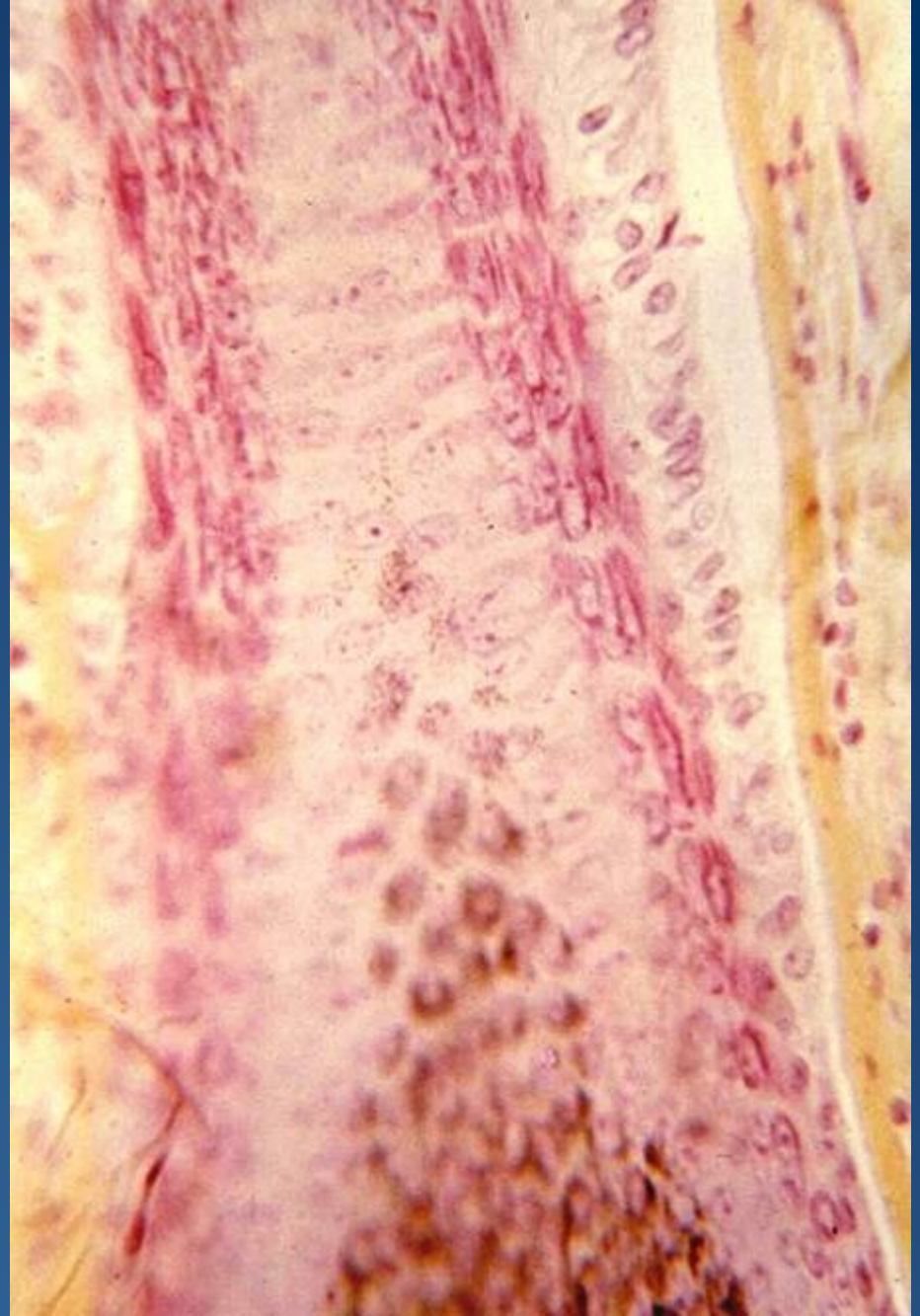
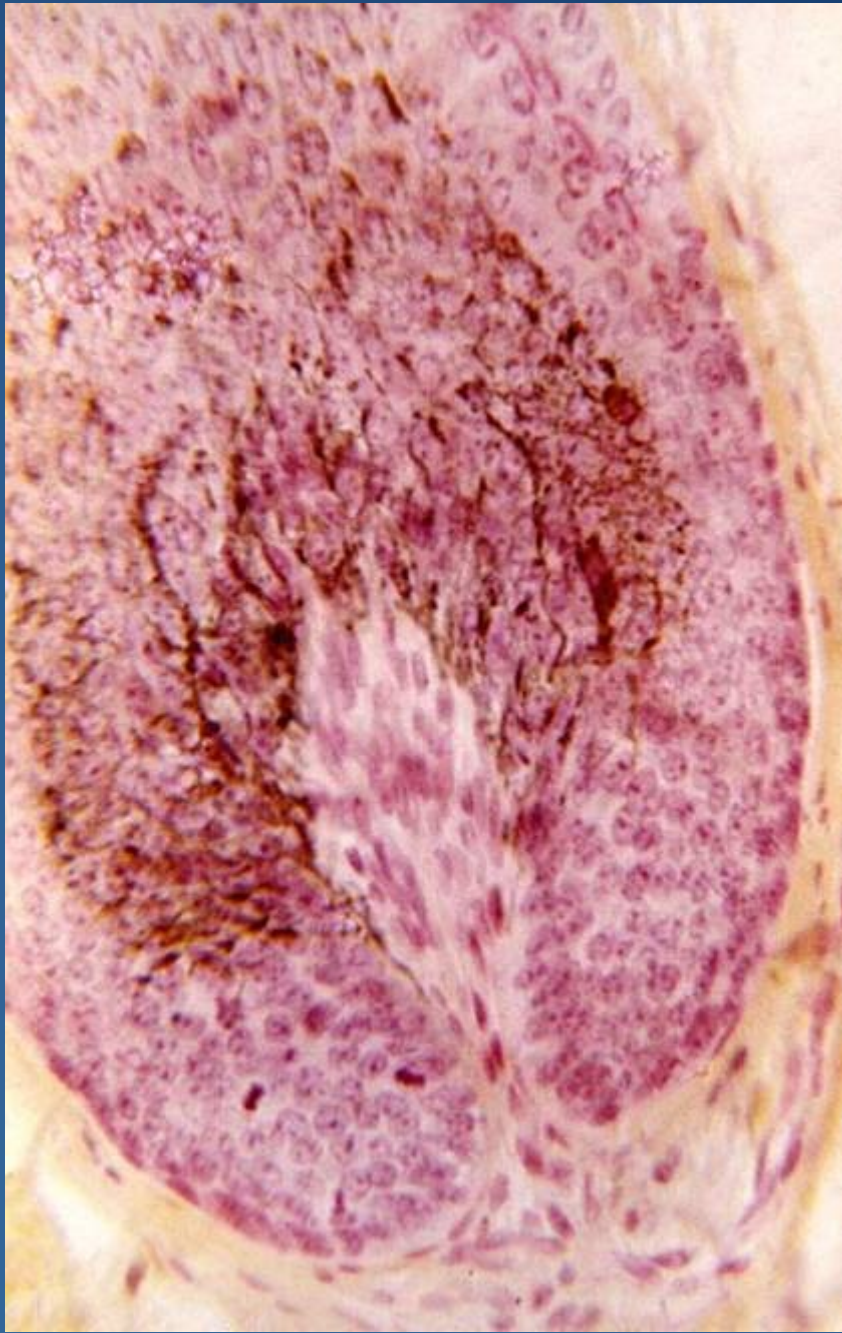
envelopes the hair root

- the **internal root sheath** - lies close the hair and comprises three layers: **Henle's** and **Huxley's layers**, which contain eosinophilic trichohyaline granules, and the **cuticle** of keratinised cells; the internal root sheath grows from the hair bulb and its cells gradually keratinise towards the neck of the hair follicle (the neck = region of the opening of sebaceous gland)
- the **external root sheath** - is continuous with the germinal epidermal layer and thins towards the hair bulb; it consists of lightly stained cells and the basement membrane
- the **connective tissue sheath** - thin leaf of dense collagen tissue that links the hair to its surrounding tissue

musculus arrector pili or **arrector pili muscle** is a bundle of smooth muscle cells stretched between the lower portion of the hair follicle and the superficial layer of dermis at the side where the loose hair end makes a sharp angle with the epidermis

contraction of the arrector pili muscle causes a depression of the skin where the muscles attach to the dermis. This produces the "**gooseflesh**"



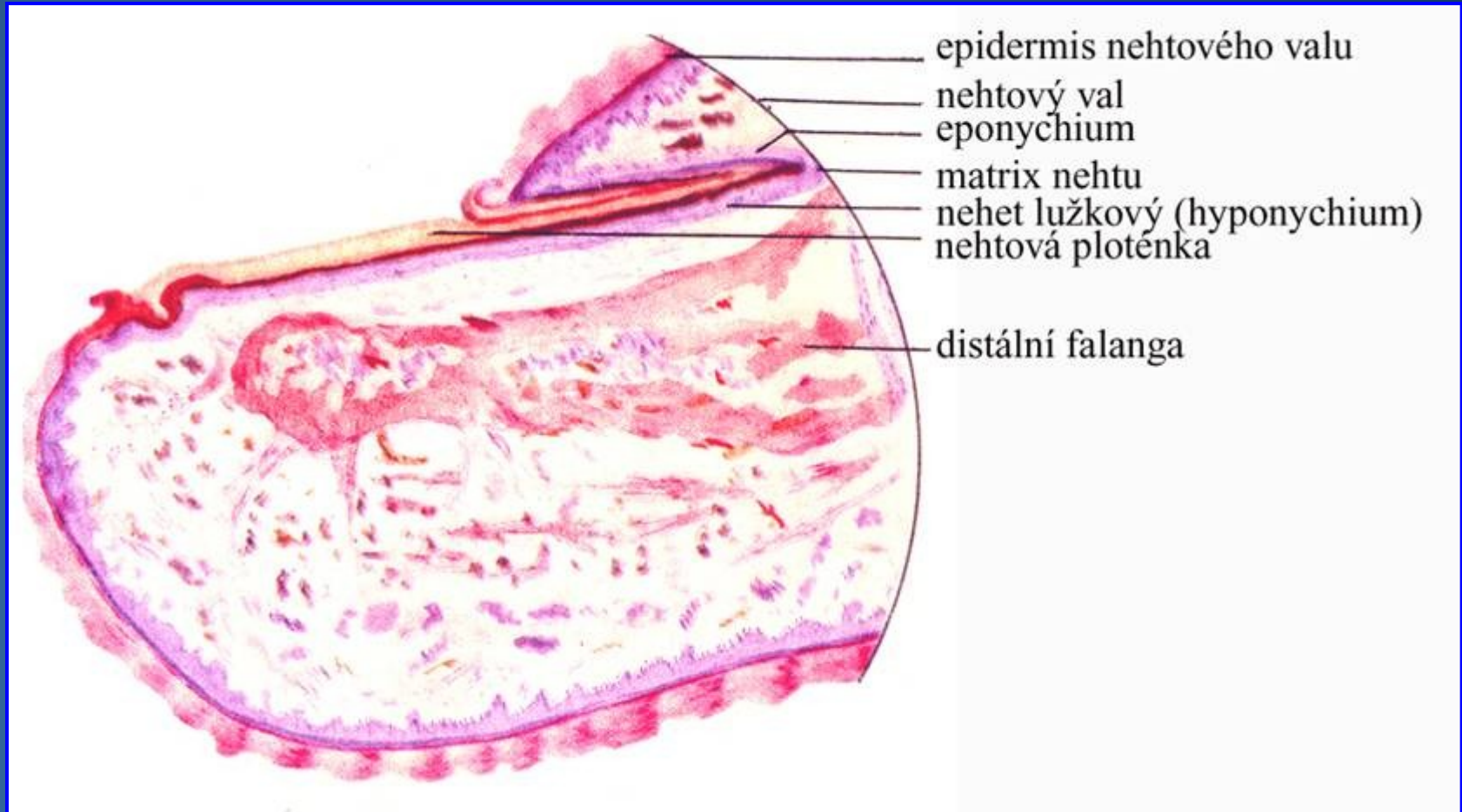


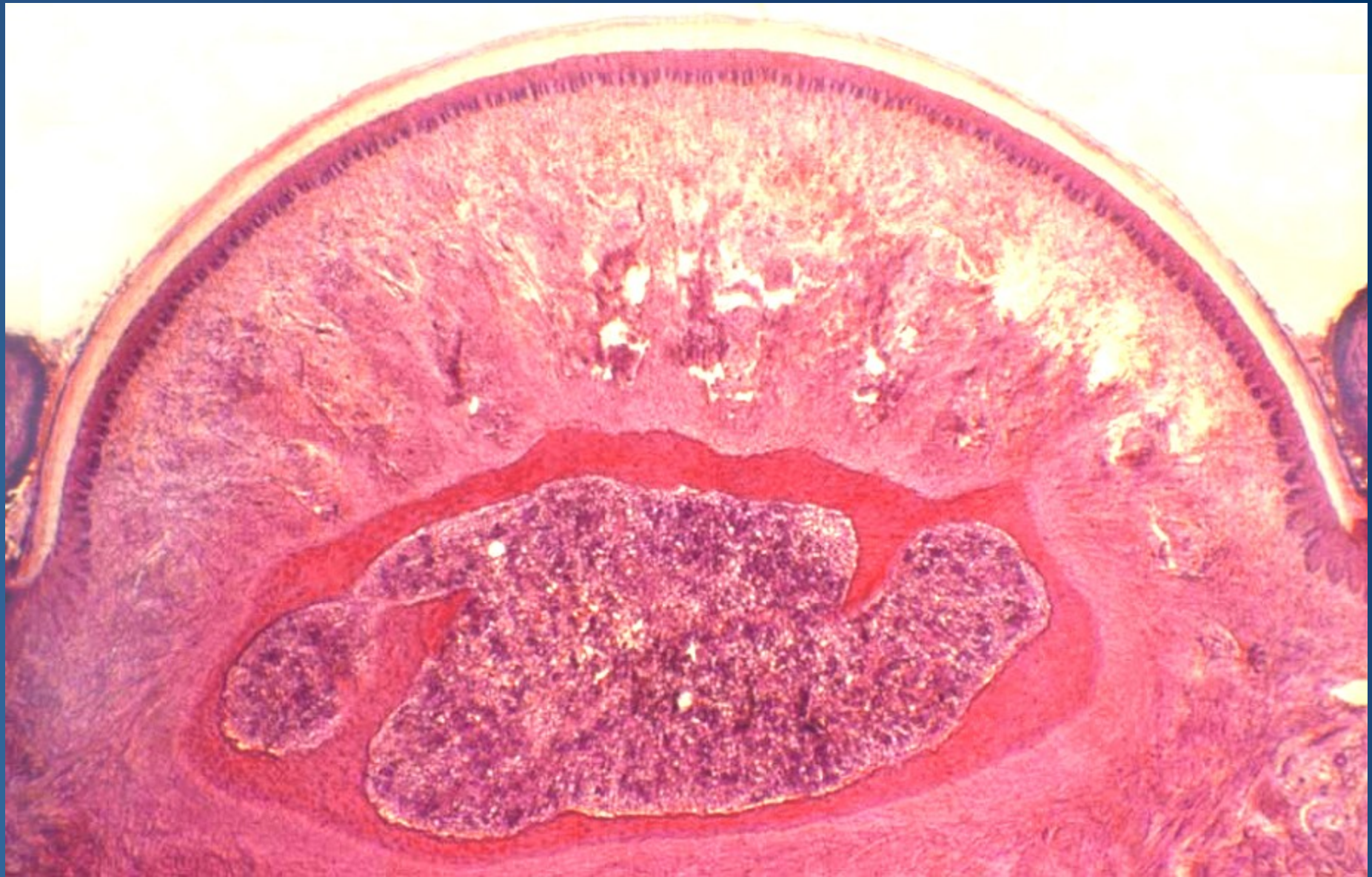
NAILS

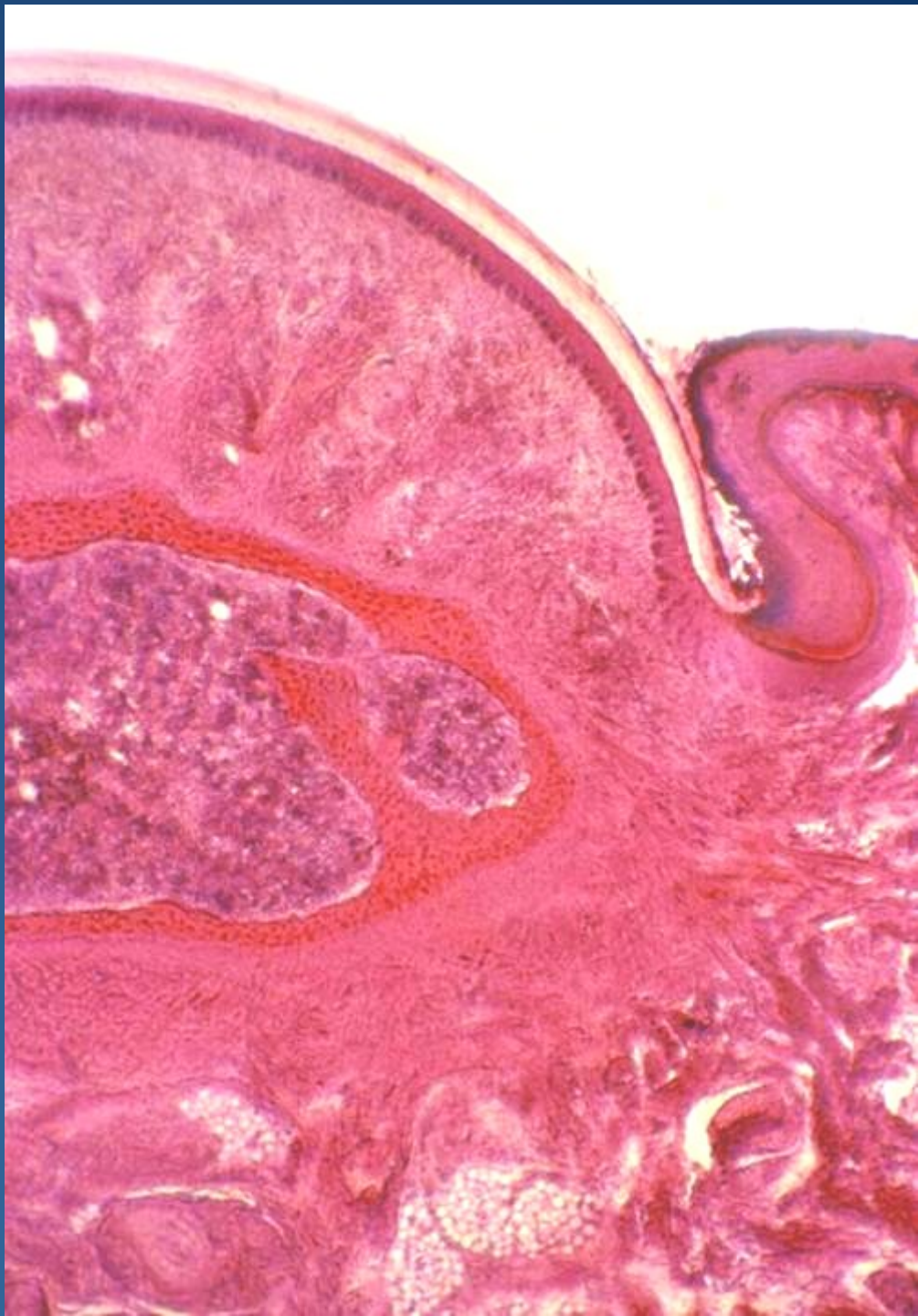
plates of keratinised epithelial cells on dorsal aspect of distal phalanxes (phalanges)

- the proximal part of the nail, hidden in the nail groove, is the **nail root**
- the nail root is covered with eponychium (or cuticle)
- the **nail plate** - corresponds to the stratum corneum of the skin
- rests on a bed of epidermis termed the **nail bed** - is composed of stratum basale and the stratum spinosum

The cells of the nail bed that are under the root of the nail constitute the **matrix**.







MAMMARY GLANDS

are modified apocrine sweat glands producing **milk**

each mammary gland consists of 15-25 lobes which are separated each others by dense connective tissue
lobes are drained with excretory **lactiferous ducts**
that open in the nipple (15-25 openings)

histological structure of mammary glands varies according to sex, age, and physiologic status

Nonlactating mammary glands

glandular tissue is reduced on only duct system, e.g. lactiferous ducts, terminal interlobular ducts and intralobular ducts

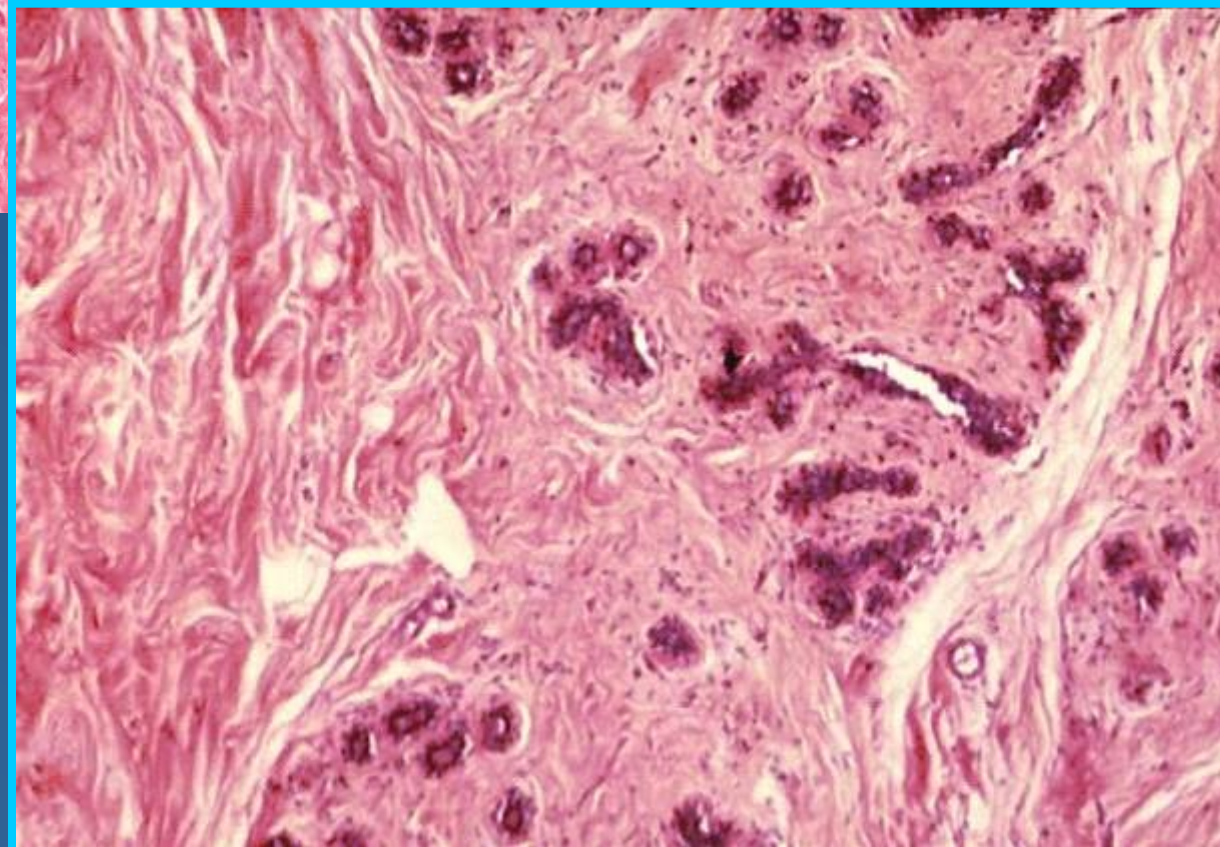
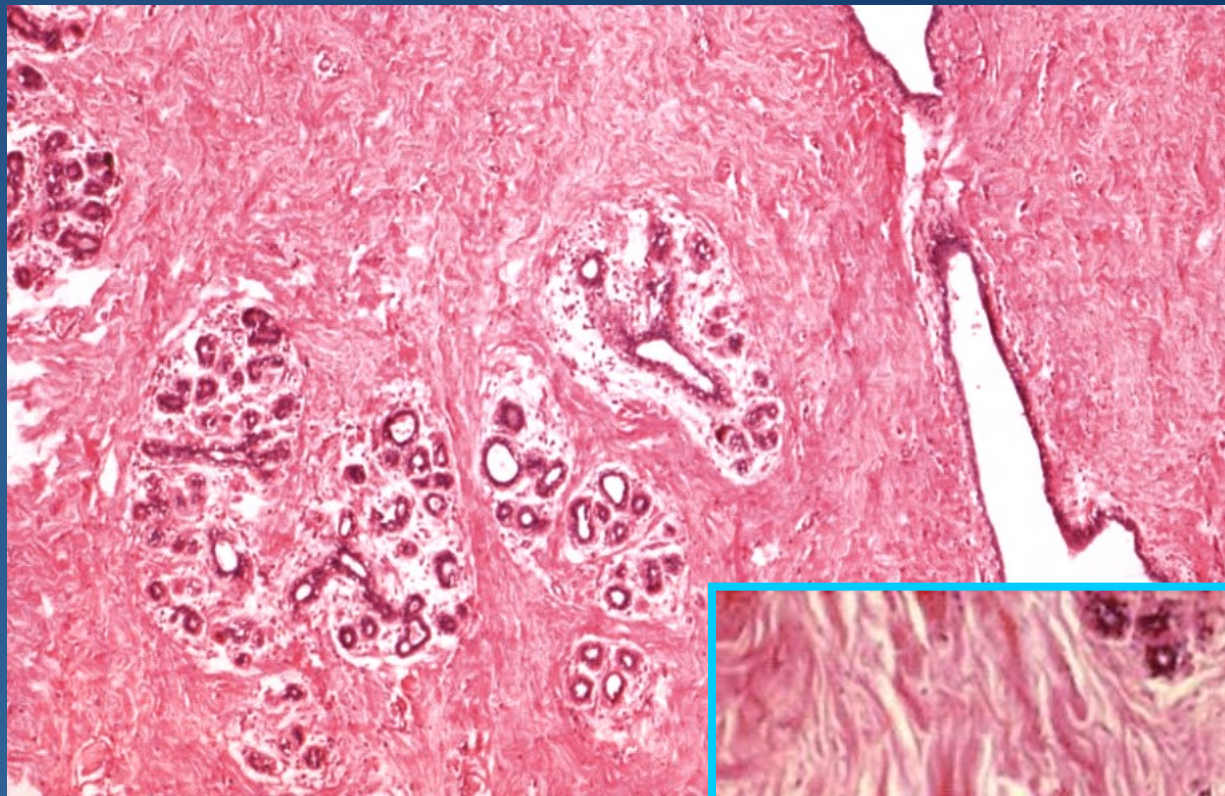
an area of one interlobular duct is a lobule

the lobules are separated by a denser, less cellular interlobular connective tissue

spaces within lobules are filled with loose intralobular tissue abundant in cells.

Gl. mammae

mamma non lactans



Lactating mammary glands

glandular tissue is fully differentiated
by thin connective tissue septa, the glandular parenchyma is
divided into the lobules

lobules contains spherical to elongated **acini** (alveoli)
differ in size

the wall of acini consist of

- the basement membrane
- cuboidal or columnar secretory cells and
- myoepithelial cells located between the basement membrane and bases of secretory cells

ducts

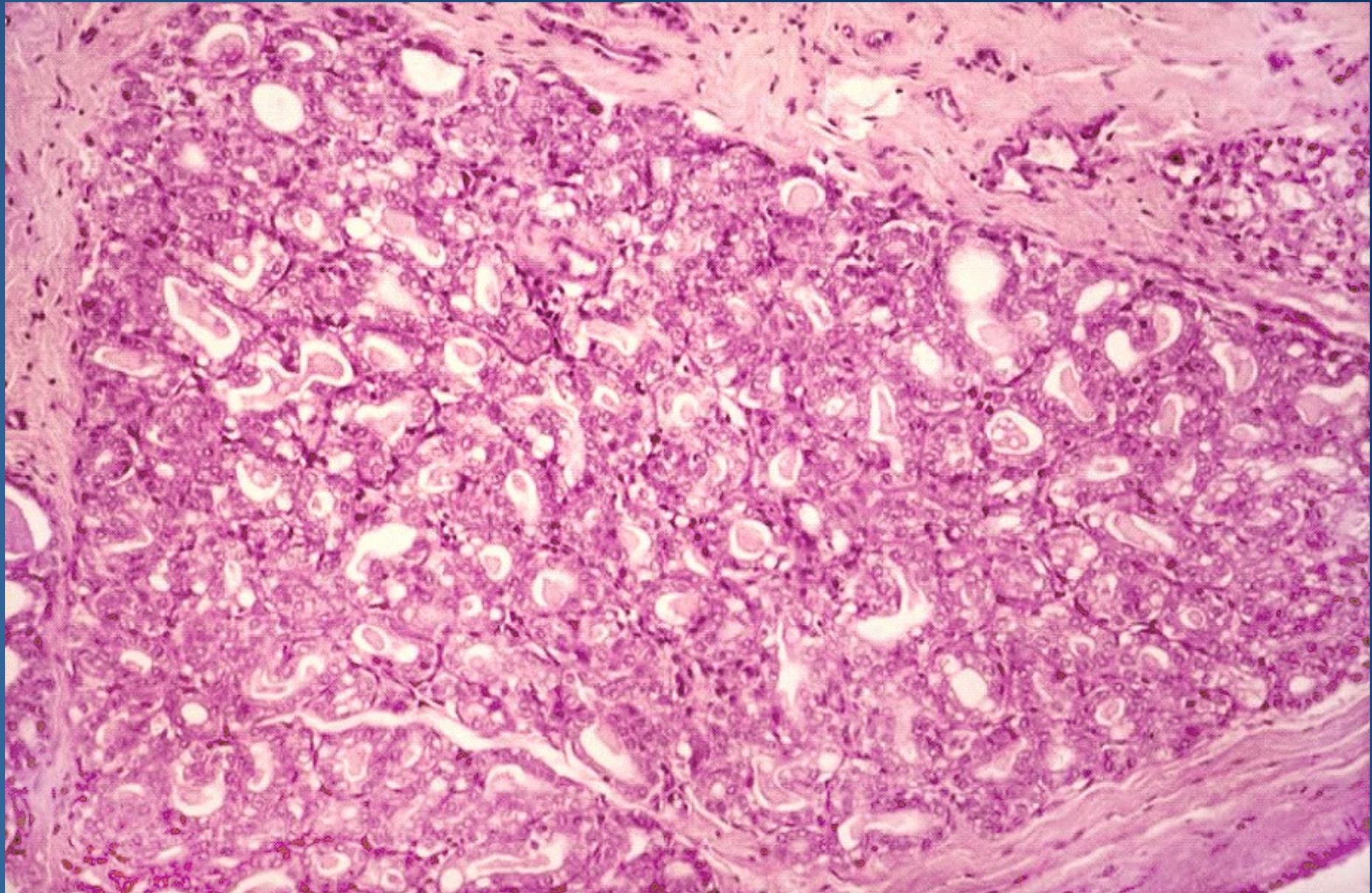
a) **intralobular ducts** lined by a simple cuboidal to columnar epithelium

b) **lactiferous ducts** lined by two layers of columnar cells which, in the lactiferous sinus, changes into stratified squamous epithelium

- the first secretion appearing after birth is called the **colostrum**
- it contains less fat and more protein than regular milk and is rich in antibodies

Gl. mammae

mamma lactans



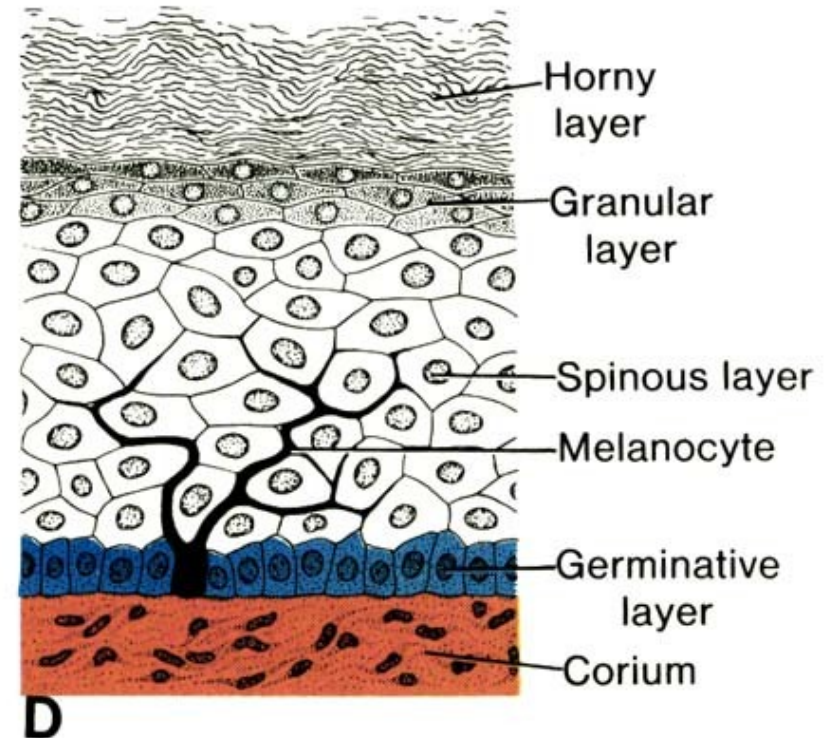
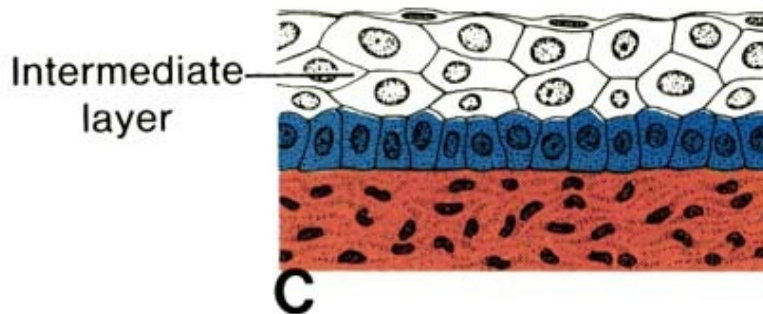
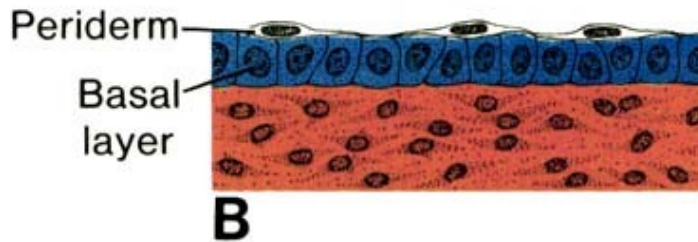
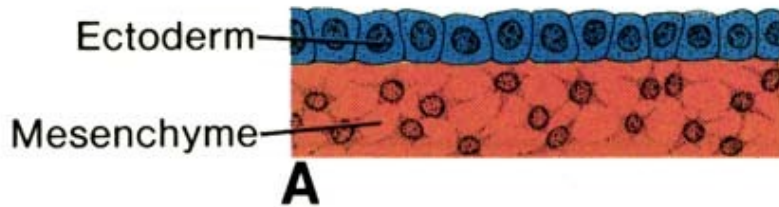
**DEVELOPMENT OF SKIN
AND
SKIN APPENDAGES**

Epidermis

initially, a single layer of ectodermal cells covers the embryo

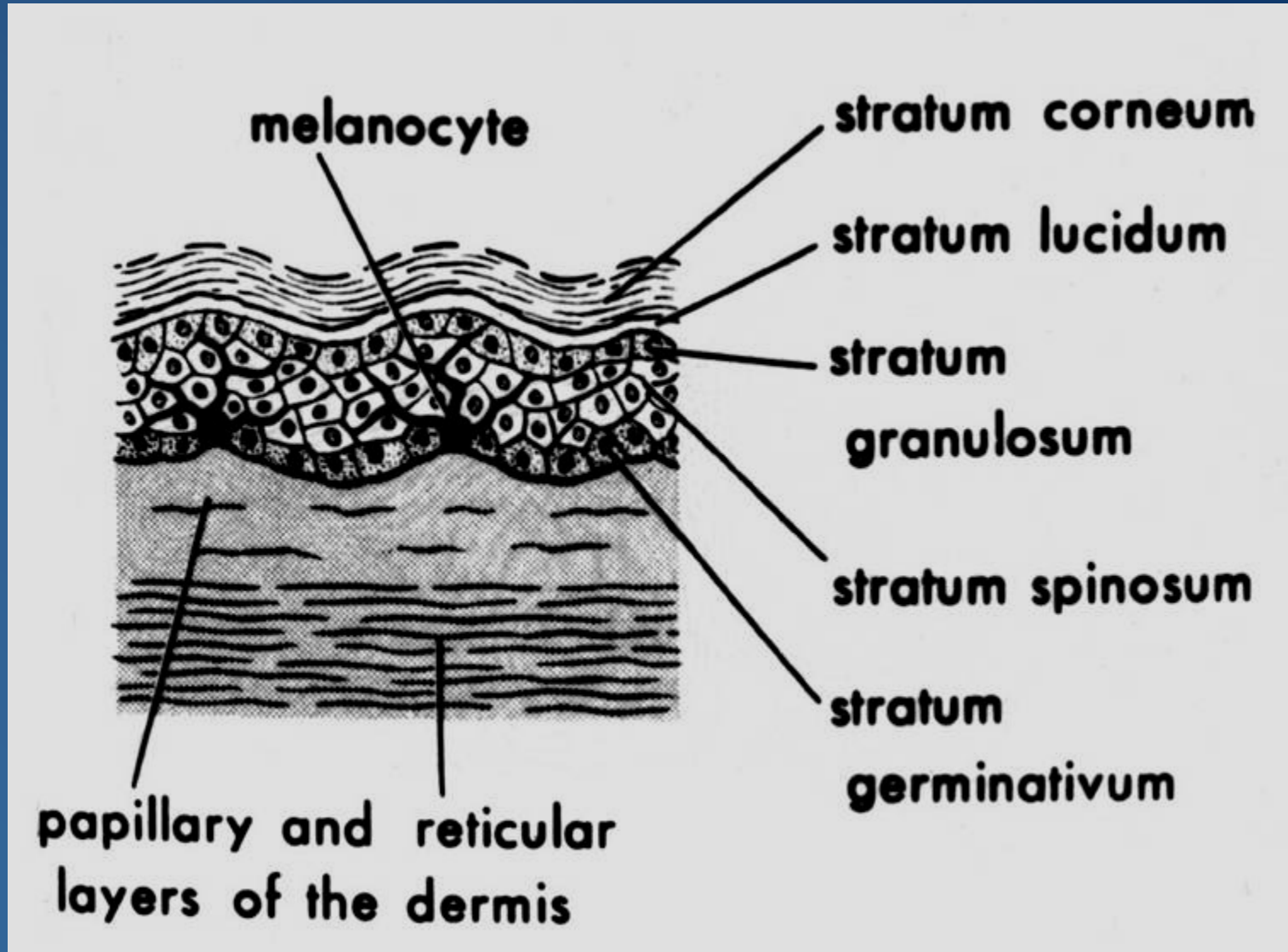
starting from the 2nd month, the ectodermal cells divide and form a superficial protective layer of flattened cells, the **periderm** or **epitrichium**

at the end of 4th month, the epidermis acquires its definitive arrangement and 4 layers are distinguished: basal, spinous, granular and horny layer



cells that have been exfoliated during fetal life form part of the **vernix caseosa**, a white, cheese-like, protective substance that covers the fetal skin

during the early fetal period, melanoblasts migrate from the neural crest to the dermoepidermal junction, where they differentiate into melanocytes



Dermis

the dermis is derived from the mesenchyme underlying the surface ectoderm

the mesenchyme arises from 2 sources:

- from the somatic layer of lateral mesoderm (most of the mesenchyme),
- from the dermomyotome regions of the somites (in lesser extent)

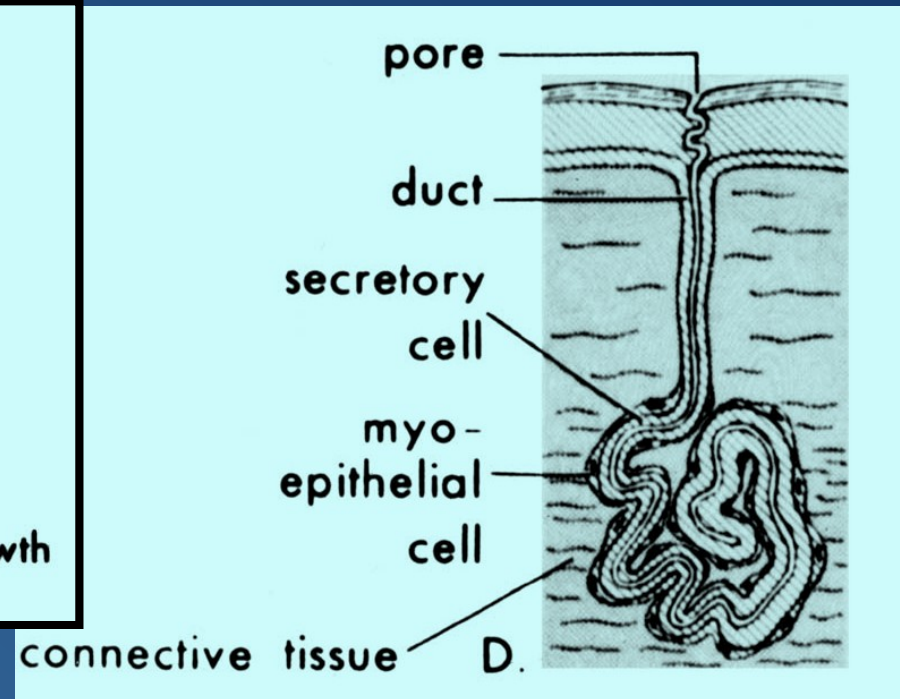
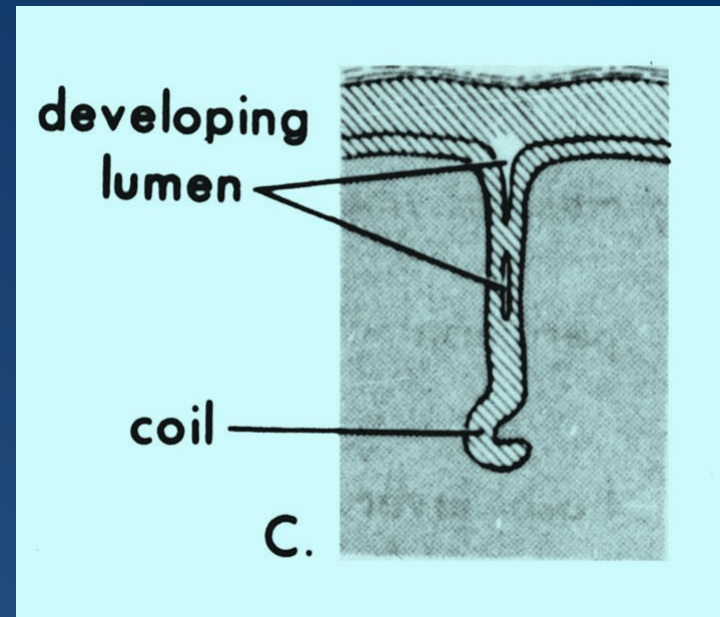
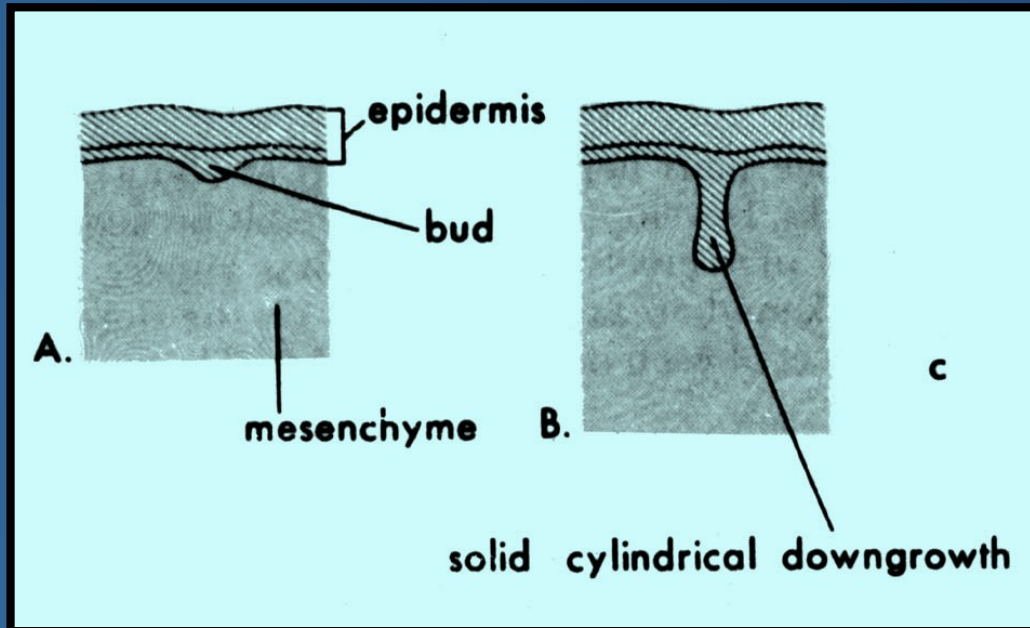
by 11 weeks, the mesenchymal cells have begun to produce collagenous and elastic connective tissue fibers

as the epidermal ridges form, the dermis project upward into the epidermis and forms **dermal papillae**

Eccrine sweat glands

develop as solid epidermal downgrowths that extend into the underlying dermis

as buds elongate, their ends become coiled, forming the primordia of future secretory portions of glands

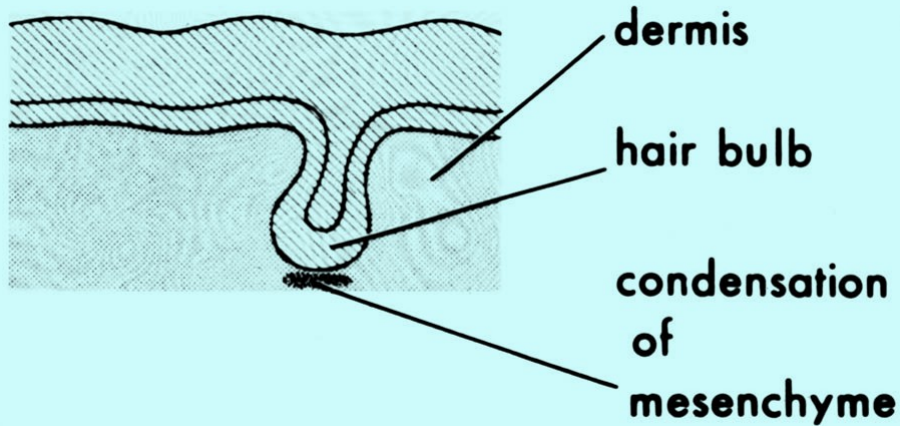
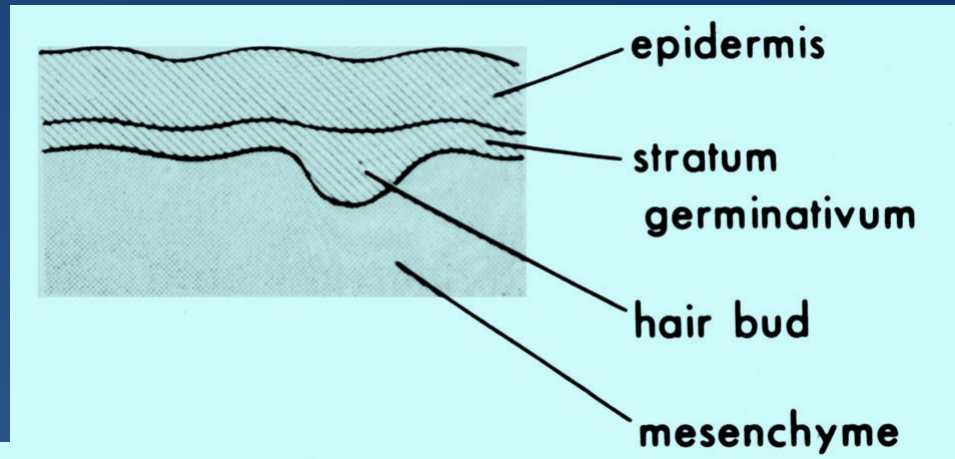


Development of hairs

they develop early in the fetal period, but they do not become readily visible until about 20th week

first recognizable hairs occur on the eyebrows, upper lip, and chin

a hair follicle begins to develop as a solid downgrowth of the stratum germinativum of the epidermis called the hair bud it extends into the underlying dermis



the deepest part of the **hair bud** soon becomes club-shaped, forming a **hair bulb**

the epithelial cells of the centre of the hair bulb constitute the germinal matrix - it gives rise to proper **hair**

the hair bulb is then invaginated by a small mesenchymal **hair papilla**

the peripheral cells of the developing hair bud (follicle) form the **epithelial root sheath**

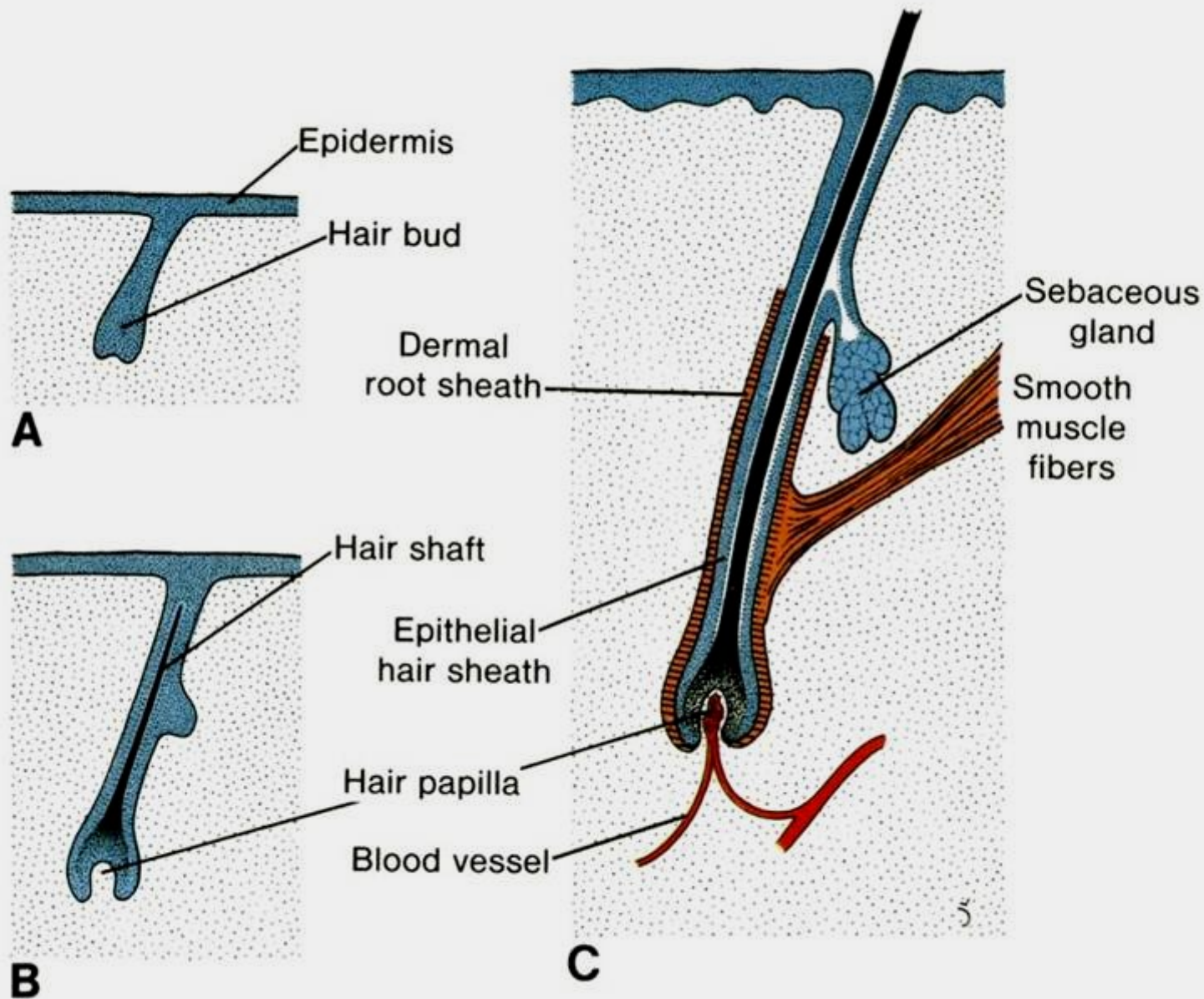
the surrounding mesenchymal cells differentiate into the **dermal (connective tissue) root sheath**

the first hairs are called **lanugo**, are fine and colourless

lanugo is replaced during the perinatal period by coarser hairs, called **vellus**

these hairs persist over most of the body, except in the axillary and pubic regions

hairs of those regions are replaced during puberty



apocrine sweat glands (axilla, pubic region, anal region, areolae) develop from the hair follicle as sebaceous glands

Development of mammary gland

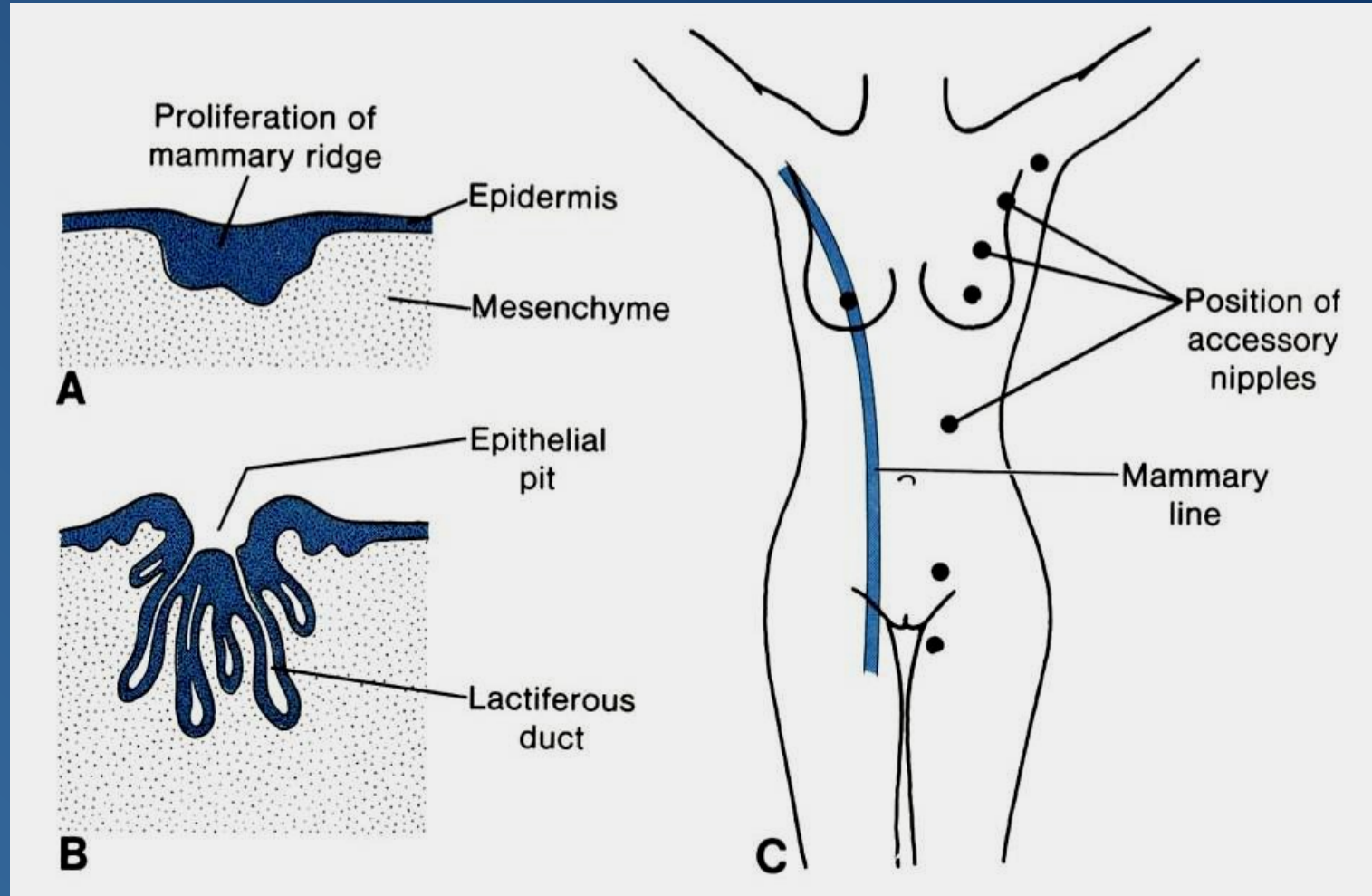
mammary glands develop during the 6th week as a solid downgrowth of the epidermis that grow against the underlying mesenchyme

downgrowths occur along the mammary ridges - two thickened strips of ectoderm that run from the axillary to the inguinal regions

in human embryos, mammary ridges occur during the 4th week, but except the pectoral area rapidly disappear

each **primary mammary bud** soon gives rise to several **secondary buds** that develop into **lactiferous ducts** and their branches

the fibrous connective tissue and fat develop from the surrounding mesenchyme



Nails

toenails and fingernails begin to develop at the distal ends of digits at about **10 weeks**, development of fingernails precedes that of the toenails

the nails first appear as thickened areas of the developing epidermis on the dorsal aspect of each digit

the **nail fields** are surrounded laterally and proximally by folds - **nail folds** cells from the proximal nail fold grow over the nail field and become keratinised to form **the nail**, or **nail plate**

at first, superficial layers of epidermis called **the eponychium** cover the developing nail, this later degenerates, except at the base of the nail, where it persists

